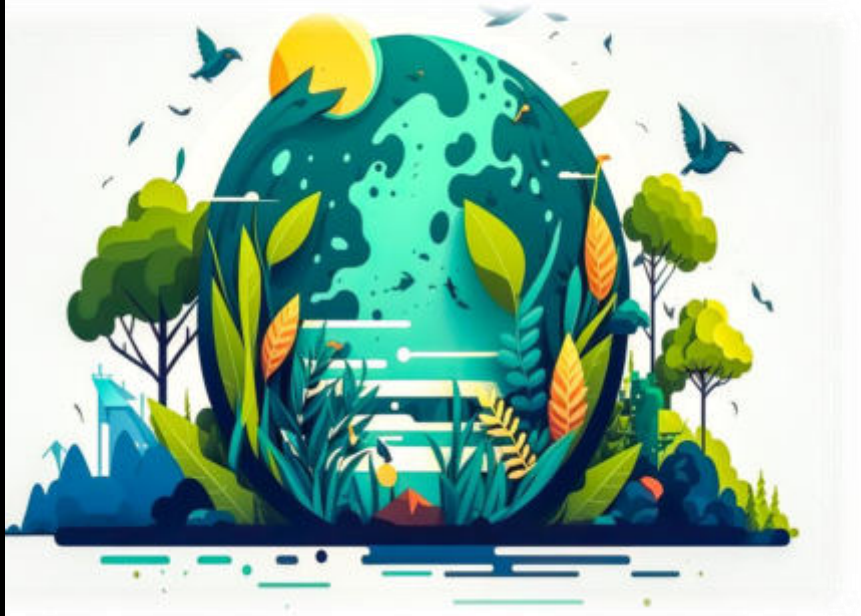
Environmental Facts



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Publisher
Vandana Publications
|| Lucknow || Kolkata ||

Published by
Vandana Publications
UG-4, Avadh Tower, Opp. Kaysons Lane, Naval Kishore Road,
Hazratganj, Lucknow – 226001, Uttar Pradesh, India
Email: info@vandanapublications.com

ISBN
978-93-90728-61-9

First Published
December 2023

All disputes are subject to Lucknow jurisdiction only.

Printed At
Yellow Print, G-4, Goel Market, Lekhraj Metro Station, Indiranagar,
Lucknow, India.
Ph: +91-7499403012
E-mail: yellowprints12@gmail.com

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Preface

Mahatma Gandhi is quoted as saying, “Earth provides enough to satisfy every man’s needs, but not every man’s greed.” What was Gandhi trying to convey with that statement? Maybe, the Earth does not have limitless resources for human consumption and we as humans impact the health of the planet by the choices we make. All humans live on one planet, planet Earth. Some call Earth “Mother Earth” because Earth nurtures life just like a mother. Human societies throughout history have symbols and depictions of Earth as a nurturer since every species on Earth depends on the resources of the planet for existence. Environmental facts are having good health by occupying pleasant, stimulating environments that support well-being. It promotes interaction with nature and also creates an enjoyable personal environment (both in and out of your workspace). Everyone can have a strong environmental consciousness simply by raising their awareness and incorporating features that help to make their setting more agreeable to them. The core principle of environmental facts is respect—respect for all nature and all species living in it. When you become environmentally aware, you will be able to realize how your daily habits affect your home life as well as your work life. Improving environmental facts is simple and results in a more balanced lifestyle. The book is a perfect example of the same venture with the aim of making each reader environment facts aware and open horizons of research for future endeavours.

Dr. Alka Vyas

About the Book

Environmental Health is being challenged globally by a number of factors. The fast-paced development has led to several problems that are interrelated and variable, ill-defined, incomplete, challenging and difficult to resolve. Climate change, deforestation, urbanization, loss of biodiversity, STDs, zoonotic illnesses, and other concerns are examples of various factors when it comes to current global health emergencies. These issues are among the continuing challenges in global health because they are complicated, multidimensional, and significantly influenced by social, economic, and political variables. The 21st century faces unprecedented environmental changes, from climate change and urbanization to deforestation, biodiversity, loss of natural resources and habitat. Accelerated economic growth with high consumption level in developed countries and aspirations of developing countries to reach matching levels of growth are continuing to damage our planet. As Earth's ecosystems are disrupted, we face the loss of ecosystem services and even the spread of zoonotic disease, COVID-19 is an example to it. Developing nations like India face even bigger challenge as India is one of the fastest growing economies of the world and will continue its rapid urbanisation and economic development in the coming decades. Unfortunately, this growth is at the cost of degrading environment health in the form of rising consumption and demand for energy, increasing greenhouse gas emissions, and constraints on critical natural resources such as land, water and biodiversity harboured by them.

Every problem has a solution and an old adage says "When there is a Will there is a Way". This book not only discusses the reasons and effects of the environmental damage but also about the way out for a better and healthy environment and Environment. A collective effort, cooperation and commitment from all sectors of society needs to be thoroughly comprehended for a better environment for us and our next generations.

Dr. Gargi Rana

Contents

Chapter -1

Causation, Manifestations, and Advanced Remediation Modalities of Metal Intoxication - A Holistic Context of Indian Subcontinent

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Abstract: Metal poisoning, also known as heavy metal toxicity, is a serious problem in India. Heavy metals are toxic elements that can have a detrimental effect on human health. Heavy metal poisoning in India include Industries, Water, Air and Soil. Heavy metal exposure can lead to a range of health problems, depending on the type of metal and the level of exposure. Some of the common symptoms ofheavy metal toxicity include fatigue, muscle weakness, headaches, abdominal pain, and tremors. Long-term exposure can lead to more severe health problems such as kidney damage, neurological disorders, and cancer. The Indian government has taken several measures to address the problem of heavy metal poisoning in India, such as the setting of heavy metal exposure standards, the enforcement of regulations on heavy metal-containing products, and the promotion of heavy metal-free alternatives. However, much more needs to be done in terms of implementing effective policies and monitoring their implementation to curb heavy metal poisoning in the country. This paper looks into the causes, effects and advanced treatment solutions.

Keywords: Soil pollution, water pollution, metal poisoning, treatment methods

BACKGROUND

India faces an extreme situation dealing with metal poisoning. Several factors lead to the current state of the country - high population, unmonitored industrial and agricultural practices and poor implementation of government policies. There have been several reported cases of metal poisoning in India in recent years. Some examples include:

- In 2011, hundreds of people in the state of Tamil Nadu were hospitalized due to lead and mercury poisoning caused by a smelting factory in the area. The factory was releasing toxic emissions into the air and water, which were then being consumed by local residents.
- In 2014, over 500 people in the state of West Bengal were diagnosed with lead poisoning after consuming food from a local market that had been contaminated by a nearby batteryfactory.
- In 2016, over 100 people in the state of Andhra Pradesh were hospitalized due tocadmium poisoning caused by a pharmaceutical factory in the area. The factory was releasing toxic wastewater into a nearby lake, which was then being consumed by local residents.
- In 2018, over 100 people in the state of Uttar Pradesh were hospitalized due to nickel poisoning caused by a metal factory in the area. The factory was releasing toxic emissions into the air, which were then being inhaled by local residents.
- In 2020, in the state of Odisha, a large number of villagers were affected by toxic heavy metals like chromium, copper, nickel and lead in the soil and water, due to a mining company.

  These cases highlight the ongoing problem of heavy metal pollution in India and the impact it can have on public health. Many of these cases have been caused by industrial activities such as mining, metal smelting, and manufacturing, and often due to lack of proper waste management systems.

CAUSES

Some of the common sources of heavy metal poisoning in India include:

1. **Industries:** Industrial activities are a major source of heavy metal pollution in India. Many industries in India, such as mining, metallurgy, tanneries, and electroplating, release large amounts of heavy metals into the environment. These metals can contaminate water, air and soil and therefore, can cause health problems to people living or working in the proximity of these industries. The mining industry, for example, releases large amounts of heavy metals such as lead, cadmium, and zinc into the environment, which can contaminate water, air, and soil. The smelting and refining of metals also releases large amounts of heavy metals into the environment. The tannery industry is also a major source of heavy metal pollution, particularly the release of chromium, which can contaminate water, air, and soil. The release of heavy metals from tanneries can also cause health problems for workers, as well as residents living in the proximity of the tanneries. The electroplating industry also releases large amounts of heavy metals into the environment, particularly cadmium, lead, and zinc. These heavy metals can contaminate water, air, and soil and can cause health problems for workers and residents living in the proximity of electroplating facilities.
2. **Contaminated food and water:** Heavy metals can also be present in food due to contamination from heavy metal-containing pesticides, heavy metal-glazed pottery, and heavy metal-soldered cans. In addition, heavy metals can also leach into water from pipesand fixtures in buildings, particularly older buildings.
3. **Agricultural runoff:** The use of pesticides and fertilizers in agriculture can lead to the leaching of heavy metals, such as cadmium and mercury, into water resources. These heavy metals can then contaminate water sources and lead to heavy metal poisoning. When farmland is not properly managed, soil erosion can occur. This erosion can lead to heavy metals in the soil being washed into nearby water sources, leading to heavy metal contamination. Animal waste, such as

manure, can contain heavy metals, such as lead and zinc, which can be washed into nearby water sources through runoff. Heavy metals can also be present in surface runoff, which occurs when water from rain or irrigation flows over the surface of the land and picks up pollutants before flowing into nearby water sources.

4. **Lead-based paint:** Lead-based paint can release lead into the air and dust, which can be inhaled, it can also chip and peel, releasing lead dust into the environment.
5. **Natural sources:** Some minerals, such as arsenopyrite and pyrite, can release heavy metals such as arsenic, lead, and mercury into groundwater. Volcanic eruptions can release heavy metals such as lead, zinc, and copper into the air and water. Forest fires can release heavy metals, such as lead and mercury, into the air and water.Heavy metals can be present in soil due to natural erosion of the earth's crust. Some wild animals, such as certain species of fish and shellfish, can contain elevated levels of heavy metals due to the presence of these metals in their natural habitat.
6. **Occupational exposure:** Workers in industries that involve the handling of heavy metals may be at risk of heavy metal poisoning due to prolonged exposure.
7. **Traditional medicine:** Some traditional medicine practices in India may involve the use of heavy metals such as lead, mercury, and arsenic, which can cause heavy metal poisoning if used in excessive amounts.

HEALTH IMPACTS

Heavy metal poisoning can have a range of negative health impacts, depending on the type of metal and the level of exposure. Some common health impacts of heavy metal poisoning include:

1. **Neurological effects:** Exposure to heavy metals such as lead, mercury, and cadmium can cause neurological effects such as headaches, tremors, memory loss, and cognitive impairment. In severe cases, heavy metal poisoning can cause brain damage and developmental

disorders in children.

2. **Kidney damage:** Heavy metals such as cadmium and lead can cause damage to the kidneys, leading to chronic kidney disease and kidney failure.
3. **Anemia:** Heavy metals such as lead and copper can interfere with the body's ability to produce red blood cells, leading to anemia.
4. **Liver damage:** Heavy metals such as lead and cadmium can cause liver damage, leading to liver dysfunction and dysfunction in other organs.
5. **Cancer:** Long-term exposure to heavy metals such as cadmium and nickel can increase the risk of certain types of cancer, such as lung, prostate, and kidney cancer.
6. **Reproductive and developmental effects:** Heavy metals such as lead, mercury, and cadmium can also cause reproductive and developmental effects, such as stillbirths, low birth weight, and developmental delays in children.
7. **Immune system dysfunction:** Heavy metals can lead to immune system dysfunction, making individuals more susceptible to infections and diseases.

WATER TREATMENT SOLUTIONS

There are several treatment solutions for removing heavy metals from water, including:

1. **Coagulation and flocculation:** Coagulation and flocculation are chemical treatmentprocesses used to remove suspended particles, such as heavy metals, from water. The process works by adding chemicals called coagulants to the water, which cause the particles to clump together and form larger particles called flocs. Coagulation involves adding a coagulant, such as aluminum sulfate or iron salts, to the water. The coagulant neutralizes the electrical charges on the particles in the water, causing them to clump together. Flocculation is the next step, it involves gently mixing the water to encourage the particles to

form larger clumps called flocs. This can be done by using mechanical equipment such as a flocculator or by simply allowing the water to sit for a period of time. The flocs formed are large and heavy enough to settle to the bottom of a sedimentation basin or can be removed with a filter. Coagulation and flocculation are effective in removing a wide range of contaminants, including heavy metals, bacteria, and organic matter. However, it's important to note that the process requires careful control of pH, temperature and dosage of chemicals to optimize the performance.

2. **Adsorption:** Adsorption is a water treatment process that uses adsorbent materials, such as activated carbon or zeolites, to remove contaminants, including heavy metals, from water. The process works by attracting the contaminants to the surface of the adsorbent material, where they are held in place and can be easily removed. Activated carbon is a common adsorbent material used in water treatment. Activated carbon is made from carbon-rich materials such as coal, wood or coconut shells, that have been treated with oxygen to create a porous structure. This porous structure allows for a large surface area for adsorption to take place. Activated carbon can remove a wide range of contaminants, including heavy metals, pesticides, and organic compounds. Zeolites are another type of adsorbent material that are used in water treatment. Zeolites are a group of naturally occurring minerals that have a porous structure and can remove heavy metals, such as lead and copper, from water through ion exchange. Adsorption is an effective method for removing heavy metals from water, but it requires the use of a large volume of adsorbent material. Additionally, the adsorbent material can become saturated over time and will need to be replaced. It is also important to note that the adsorbent material can release the captured contaminants if not disposed of properly. Adsorption is usually used as a polishing step after other methods like coagulation and flocculation. It is also commonly used in conjunction with other water treatment methods to achieve a higher degree of purification and to provide a barrier against the adsorbent material becoming saturated.

3. **Ion exchange:** The process works by exchanging the ions of the contaminants with ions that are already present in the resin. Ion exchange resins are made up of small beads that contain ions that can be exchanged with the ions of the contaminants in the water. The resins are typically made of synthetic polymers and come in two types: cation exchange resins, which exchange positively charged ions, and anion exchange resins, which exchange negatively charged ions. Cation exchange resin can remove positively charged ions, such as heavy metals like lead, copper and zinc, from water. Anion exchange resin can remove negatively charged ions, such as nitrate and fluoride. The ion exchange process can be performed in a batch process or in a continuous flow process. In a batch process, a fixed bed column filled with resin beads is used, while in a continuous flow process, a resin bed column is used. Ion exchange is an effective method for removing heavy metals from water and it can be used to remove a wide range of contaminants. However, it is important to note that the process requires regular replacement of the resin beads, and it can also generate waste brine that needs to be managed and treated properly. Additionally, the ion exchange resins can also be saturated over time and need to be regenerated or replaced. It is also important to consider the pH and temperature of the water, as well as the specific type and concentration of heavy metals, to achieve optimal performance of the process.
4. **Reverse osmosis:** The process works by applying pressure to the water, which forces it through the membrane, leaving the contaminants behind. RO systems typically consist of several stages, including pre-treatment, filtration, and post-treatment. Pre-treatment includes processes such as coagulation and flocculation to remove suspended particles and sediment, followed by carbon filtration to remove chlorine and organic compounds that can damage the RO membrane. The water then flows through the RO membrane, where dissolved contaminants are removed, and finally, it goes through post-treatment where the water is disinfected and remineralized. RO is an effective method for removing heavy metals from water, as well as a wide range of dissolved contaminants. However, the process requires high pressure to force the water through the membrane, which can be costly

and requires a significant amount of energy. Additionally, the RO membrane can become fouled over time, reducing its effectiveness and requiring replacement. Also, the process can also generate a high volume of reject water, which is water that contains the contaminants removed during the process and needs to be properly managed and treated. It's also important to note that, while RO can effectively remove heavy metals, it's not ideal for removing all types of contaminants, such as volatile organic compounds, and it's often used in conjunction with other methods like adsorption and ion exchange.

5. **Bioremediation:** Bioremediation is a water treatment process that uses microorganisms to remove pollutants, including heavy metals, from water. The process works by introducing microorganisms that have the ability to degrade or remove the heavy metals from the water.

   There are two main types of bioremediation:

   - Bioaugmentation: This type of bioremediation involves introducing specific microorganisms that have been selected for their ability to remove heavy metals from water. These microorganisms consume the heavy metals and convert them into less toxic forms.
   - Biostimulation: This type of bioremediation involves adding nutrients to the water to promote the growth of naturally occurring microorganisms that can remove heavy metals.

6. **Electrocoagulation:** Electrocoagulation is a water treatment process that uses electricity to coagulate or clump together particles in water, making them easier to remove. The process involves passing an electrical current through a series of electrodes, which creates an ionized field that causes the particles to coagulate. This process can be used to remove a wide range of contaminants, including heavy metals, oil, and bacteria, and is often used in industrial and municipal wastewater treatment. Electrocoagulation can be an effective way to treat water in remote or off-grid locations where other treatment methods may not be feasible.

SOIL TREATMENT SOLUTIONS

There are several treatment solutions for removing heavy metals from soil, including:

1. **Phytoremediation:** Phytoremediation is a process that uses plants to remove pollutants, including heavy metals, from soil, water and air. The plants absorb the pollutants through their roots or leaves and convert them into less toxic forms or store them in above-groundparts. The plants can then be harvested and disposed of safely.

   There are several types of phytoremediation techniques:

   - Hyperaccumulation: This technique involves using plants that have the ability to accumulate large amounts of heavy metals in their tissues without suffering any damage. These plants are known as hyperaccumulators. Some examples of hyperaccumulator plants include Indian mustard, sunflowers, and willow trees.
   - Phytoextraction: This technique involves using plants to remove heavy metals from the soil by taking them up through the roots and storing them in the above-ground parts of the plant. The plant can then be harvested and safely disposed of.
   - Phytostabilization: This technique involves using plants to immobilize heavymetals in the soil, making them less mobile and less likely to contaminate water sources.
   - Phytovolatilization: This technique involves using plants to convert heavy metals into volatile forms which are then released into the air, where they can be captured and removed.
   - Rhizofiltration: This technique involves using plants to remove heavy metals from water. The plants absorb the heavy metals through their roots and store them in their above-ground parts.
2. **Soil washing:** This process involves the physical removal of contaminated soil through the use of water or other liquids to dissolve and wash away the heavy metals.
3. **Bioleaching:** Bioleaching is a process that uses microorganisms, such as bacteria and fungi, to remove heavy metals from soil, water and

mining waste. The microorganisms consume the heavy metals and convert them into less toxic forms or store them in their biomass. Bioleaching can be performed in situ (in the location where the heavy metals are present) or ex situ (in a separate location where the contaminated materials are brought to). Bioleaching is a cost-effective and environmentally friendly method for heavy metal remediation, as it does not require the addition of chemicals and generates less waste than traditional methods.

There are two main types of bioleaching:

- Microbial-induced leaching: This type of bioleaching uses naturally occurring microorganisms that are present in the environment to remove heavy metals from the soil or water.
- Bioaugmentation: This type of bioleaching involves the introduction of specific microorganisms that have been specifically selected for their ability to remove heavy metals from the soil or water.

4. **Thermal desorption:** Thermal desorption is a process that uses heat to remove heavy metals from contaminated soil. The process works by heating the contaminated soil to high temperatures, which causes the heavy metals to vaporize. The vaporized heavy metals can then be captured and removed using a variety of methods, such as adsorption or condensation. Thermal desorption is a highly effective method for removing heavy metals from contaminated soil, as it can remove a wide range of contaminants, including volatile and semi-volatile compounds. It is also relatively quick and can be performed on a large scale. However, it is important to note that thermal desorption requires significant amounts of energy and can be costly.

   There are two main types of thermal desorption:

   - In-situ thermal desorption: This type of thermal desorption is performed on-site, where the contaminated soil is located. The soil is heated using specialized equipment, such as electric heating elements or hot air.
   - Ex-situ thermal desorption: This type of thermal desorption is

performed off-site, where the contaminated soil is removed and brought to a separate location for treatment. The soil is heated using specialized equipment, such as rotary kilns or fluidized bed reactors.

5. **Chemical fixation:** Chemical fixation is a process that uses chemicals to immobilize heavy metals in contaminated soil, making them less mobile and less likely to contaminate water sources. The process works by adding chemicals to the contaminated soil that react with the heavy metals, forming insoluble compounds that cannot be taken up by plants or animals. Chemical fixation is a cost-effective method for immobilizing heavy metals in soil and can be performed on-site, making it a feasible option forlarge-scale remediation projects.

   There are several types of chemical fixation methods:

   - Phosphate fixation: This method uses phosphates to react with heavy metals such as lead, zinc and copper, to form insoluble compounds that are not bioavailable.
   - Sulphate fixation: This method uses sulphates to react with heavy metals such as cadmium, lead, and zinc to form insoluble compounds that are not bioavailable.
   - Carbonate fixation: This method uses carbonates to react with heavy metals such as lead and zinc to form insoluble compounds that are not bioavailable.
   - Lime fixation: This method uses lime (calcium oxide) to react with heavy metals such as lead, zinc and copper to form insoluble compounds that are not bioavailable.

6. **Landfarming:** Landfarming is a process that uses the natural processes of microorganisms in the soil to degrade or remove pollutants, including heavy metals, from contaminated soil. The process involves spreading contaminated soil over a large area and then incorporating it into the soil with tillage equipment, allowing the microorganisms to degrade or remove the heavy metals. Landfarming is a relatively low-cost method for removing heavy metals from contaminated soil and can be performed on-site, making it a feasible

option for large-scale remediation projects.

The process can be divided into several steps:

- Site preparation: The site is prepared by clearing and grading the area to create alevel surface.
- Soil spreading: The contaminated soil is spread over the prepared site in a thinlayer.
- Incorporation: The contaminated soil is incorporated into the soil using tillageequipment such as plows, discs, or harrows.
- Monitoring: The site is monitored for changes in the soil chemistry and for thepresence of any pollutants.
- Harvesting: The treated soil is harvested and removed from the site.

The appropriate treatment method will depend on the specific type and concentration of heavy metals present in the soil, as well as the desired level of treatment. It is important to note that it isalso important to implement measures to prevent heavy metal contamination in soil, such as proper waste management and regulation of industries that are known to release heavy metals into the environment.

GOVERNMENT POLICIES

The government of India has implemented a number of policies and laws to address pollution in the country. The Water (Prevention and Control of Pollution) Act of 1974 and the Air (Prevention and Control of Pollution) Act of 1981 are two major laws that aim to control and prevent pollution in India. These laws establish the Central Pollution Control Board (CPCB) and State Pollution Control Boards (SPCBs), which are responsible for monitoring and enforcing pollution control regulations. The National Green Tribunal (NGT) is a specialised court in India that deals with environmental disputes. It was established in 2010 under the National Green Tribunal Act 2010, to deal with the expeditious disposal of

cases relating to environmental protection and conservation of forests and other natural resources. The Government of India has also launched several national and state-level policies and schemes to address air and water pollution, such as the National Clean Energy Fund (NCEF), the National Action Plan on Climate Change (NAPCC), the National Clean Energy Fund (NCEF), the National Mission for Clean Ganga (NMCG), and the National River Conservation Plan (NRCP) The National Clean Air Programme (NCAP) was launched in 2019, which aims to reduce air pollution across the country by 20-30% by 2024 through a combination of regulatory and non-regulatory measures. In addition, the government has also launched several schemes to promote clean energy and energy efficiency, including the Ujjawal Discom Assurance Yojana (UDAY) and the Pradhan Mantri Sahaj Bijli Har Ghar Yojana (Saubhagya). Overall, the Indian government has implemented a number of policies and laws to address pollution and protect the environment, but their implementation and effectiveness are still debated.

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Chapter - 2

Study of Industrial Pollution of River Khannaut (Shahjahanpur) with reference to Biochemical Changes in a Freshwater Fish Channa punctatus

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Abstract: The aquatic pollution and degradation have become very serious problem. The industrial wastes, if discharged untreated into the river, can adversely affect the aquatic ecosystem. Industrial effluents from sugar & wine factories are mixing in the Khannaut river passing through the Shahjahanpur district of Uttar Pradesh. Samples of water from unpolluted and polluted sides were collected to study the impact of pollution on this river due to the presence of effluents.The physio-chemical parameters like alkalinity, total hardness, BOD, COD, Chloride, and calcium. The result obtained showed variations in these parameters, which indicate about the intensity of water pollution.

The alkalinity ranged from minimum of 108 to max 107 mg/l, total hardness from 115 to 175mg/l, BOD from 1.3 to 2.9, COD from 15 to 45mg/l, Chloride from 12 to 32mg/l and Calcium from 25 to 55mg/l The comparison of these values for unpolluted and polluted sites indicated that there were increase in all the values of the respective parameters like Alkalinity, total hardness, BOD, COD, Chloride and Calcium due to mixing of effluents from these sugar and wine industries. Data about the catch of fish *Channa punctatus* were collected from unpolluted site. (Mishripur) and polluted sites (Roserkothi & Daniapur) and these

fishes were used for their biochemical studies to determine the impact of industrial effluents.

Keywords: - Industrial effluents, Channa punctatus, Alkalinity, Total Hardness, BOD, COD, Chloride & Calcium

INTRODUCTION

In the modern era of industrialization, pollution is the most serious problem which every living being is facing today. Industrialization and urbanization are the main causes for the water pollution. Cooper, (1941); Morre, (1977) & Smith, (1980) have examined the alkalinity of polluted water. They pointed out the industrial wastes have already altered the physical, chemical & biological characteristics of various water bodies.

The quality of water is usually determined by the Biochemical Oxygen Demand (BOD) & Chemical Oxygen Demand (COD). As a consequence, several scientists have reported changes in BOD (Burns & Marshall, 1965; Baumann, 1974 & Pitwell, 1983). Chloride is present in low quantity in fresh water (Bond & Straul, 1973), but high concentration of Chlorides may be present due to mixing of effluents of different chemicals discharges (Little, 1971). The elemental composition of Calcium is also reported in some of these effluents by Jayabalan et al. (1994).

MATERIAL & METHODS

Industrial effluents from sugar & wine factories are mixing in the Khannaut river passing through the Shahjahanpur district of Uttar Pradesh. Samples of water from unpolluted and polluted sides were collected to study the impact of pollution on this river due to the presence of effluents.The physio-chemical parameters like alkalinity, total hardness, BOD, COD, Chloride, and calcium. The result obtained showed variations in these parameters, which indicate about the intensity of water pollution.

Total Alkalinity was calculated as follows: -

Total Alkalinity (mg/l, as $CaCO_3$) = (2B-C) x N x 50,000 / ml sample

Where, B=ml titrant to first recorded pH, C= total ml titrant to reach pH 0.3 unit lower & N= normality of acid

Total Hardness was calculated as follows: -

Total Hardness (mg/l, as $CaCO_3$) = T x 100 / V

Where, T=volume of titrant (ml), V= volume of sample (ml)

BOD was calculated as follows: -

BOD (mg/l) = (D1-D2) – (B1-B2) /P

Whereas D1= DO of diluted sample before incubation, D2= DO of diluted sample after incubation, B1= DO of control before incubation, B2= DO of control after incubation & P=Decimal fraction of the sample.

COD was calculated as follows: -

COD (mg/l) = (a-b) x N x 8,000 / ml of sample

Whereas a= ml of titrant used in control, b= ml of titrant used in sample, N= normality of titrant

Calcium was calculated as follows: -

Calcium (mg/l) = X x 400.5 x 1.05 / V

Whereas X= volume of titrant (ml), V= volume of sample (ml)

Plate 9: The catching of fish at Mishripur site.

Plate 10: Khannaut river at Mishripur site.

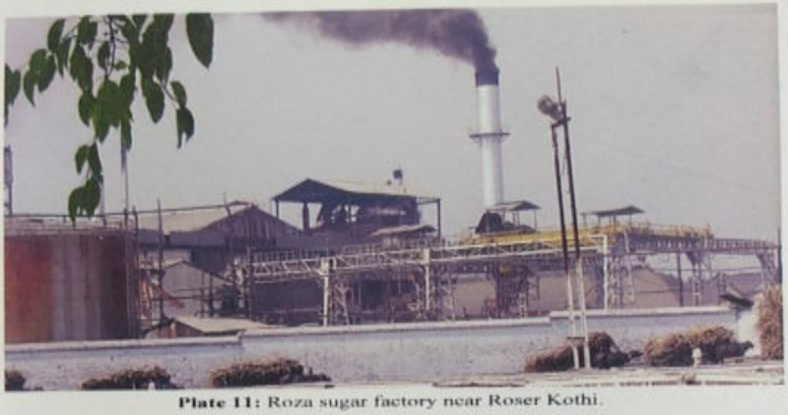

Plate 11: Roza sugar factory near Roser Kothi.

Plate 12: The untreated effluents discharged from the factory cause pollution in Khannaut river

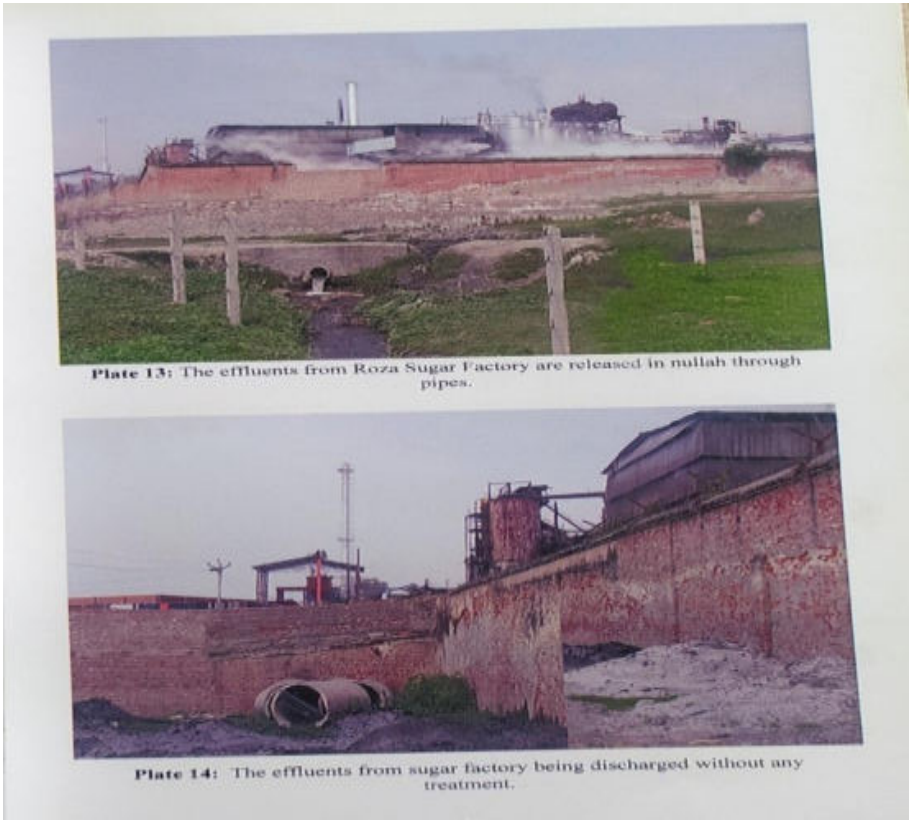

Plate 13: The effluents from Roza Sugar Factory are released in nullah through pipes.

Plate 14: The effluents from sugar factory being discharged without any treatment.

RESULTS

Data obtained of water samples from present investigation is given in Table 1-3. The results show a significant impact of effluents of sugar & wine industries on water samples. Data given in all Tables (1-3) are for the months of January - September in which alkalinity ranged from minimum of 108 to maximum 170mg/l were obtained. During January to September, the total hardness shown from 115 – 175 mg/l

BOD of water samples obtained from minimum 1.3 to maximum 2.9 mg/l

COD of water samples obtained from minimum 15 to maximum 45 mg/l

During January to September, the parameter of water samples Chloride obtained from minimum 12 to maximum 32 mg/l & Calcium obtained from minimum 25 to maximum 55 mg/l These minimum values of water samples parameters i.e., Alkalinity, total hardness, BOD, COD, Chloride & Calcium in water are obtained from the unpolluted site of Mishripur while the maximum values of these parameters are obtained from the polluted sites i.e., Rosarkothi & Daniapur.

Table1:- Effect of Industrial effluents on chemical parameters of water collected from river Khannaut

Months	Jan-06			Feb-06			Mar-06		
Parameters	**I Site**	**II Site**	**III Site**	**I Site**	**II Site**	**III Site**	**I Site**	**II Site**	**III Site**
Alkalinity (mg/l)	170	125	130	130	125	150	160	130	135
Total Hardness (mg/l)	175	145	140	135	142	145	175	145	170
BOD (mg/l)	2.8	1.5	1.8	2.5	2.0	1.8	2.9	1.9	2.0
COD (mg/l)	30	20	25	32	30	25	30	25	32
Chloride (mg/l)	22	25	28	20	25	22	32	28	26
Calcium (mg/l)	45	30	35	25	30	24	55	25	66

I Site: Mishripur (Prior to mixing of industrial effluents).

II Site: Roserkothi (After mixing of effluents from Sugar industry).

III site: Daniapur (After mixing of effluents from sugar & wine industries).

Table2: - Effect of Industrial effluents on chemical parameters of water collected from river Khannaut

Months	Apr-06			May-06			Jun-06		
Parameters	**I Site**	**II Site**	**III Site**	**I Site**	**II Site**	**III Site**	**I Site**	**II Site**	**III Site**
Alkalinity (mg/l)	130	125	115	108	112	130	108	125	120
Total Hardness (mg/l)	135	115	130	175	120	140	126	135	130
BOD (mg/l)	1.5	2.0	1.8	2.5	1.3	1.8	1.3	1.8	1.5
COD (mg/l)	25	30	35	35	16	32	16	28	20
Chloride (mg/l)	20	25	30	20	15	27	14	32	28
Calcium (mg/l)	35	30	45	31.2	30	28	32	25	26

I Site: Mishripur (Prior to mixing of industrial effluents).

II Site: Roserkothi (After mixing of effluents from Sugar industry).

III site: Daniapur (After mixing of effluents from sugar & wine industries).

Table3:- Effect of Industrial effluents on chemical parameters of water collected from river Khannaut

Months	Jul-06			Aug-06			Sep-06		
Parameters	**I Site**	**II Site**	**III Site**	**I Site**	**II Site**	**III Site**	**I Site**	**II Site**	**III Site**
Alkalinity (mg/l)	120	112	115	122	125	130	125	145	152
Total Hardness (mg/l)	116	124	120	140	145	142	123	152	175
BOD (mg/l)	1.4	1.8	1.3	1.4	1.9	1.5	1.5	2.1	2.5
COD (mg/l)	25	28	15	17	20	23	15	30	45
Chloride (mg/l)	22	20	25	18	22	25	12	16	15
Calcium (mg/l)	34	36.18	35	32	35	38	28	26	32

I Site: Mishripur (Prior to mixing of industrial effluents).

II Site: Roserkothi (After mixing of effluents from Sugar industry).

III site: Daniapur (After mixing of effluents from sugar & wine industries).

DISCUSSION

The alkalinity of water samples collected from Mishripur site ranged from 108 to 172 mg/l during the period of study. The changes in alkalinity were related to seasonal variation. The total hardness of water 115 to 175 mg/l. These values indicate only minor variations in total hardness after mixing of effluents at different sites.

BOD of water samples collected from Mishripur site ranged 1.3 to 2.9 mg/l collected from polluted sites. This shows that BOD of water was slightly affected by mixing of effluents.

COD of water ranged from 15 to 45 mg/l. These fluctuations depending upon the changes in the number of effluents discharged from wine factory.

The natural water contains small quantities of Chlorides & Calcium but when water is polluted with the industrial wastes may rise their polluted level which is dangerous for aquatic life.

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Chapter - 3

Environmental Wellness & Nature's Impact on Health

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Wellness is a holistic concept that encompasses various dimensions of our lives. In a multicultural world. Wellness acknowledges the impact of diverse experiences, such as trauma and cultural/spiritual beliefs, on our perceptions and choices. Ultimately, wellness is about leading a fulfilling, joyful, and healthy life. Creating balance in our lives is an important part of wellness. Overall, a balanced life can mean many things, depending on culture, circumstances, resources, and other factors. Our roles and relationships help define who we are, what gives us a sense of purpose, and how our lives are interdependent on other people, animals, and the environment. Wellness comprises of eight mutually co-dependence dimensions: including emotional, physical, occupational, intellectual, financial, social, environmental, and spiritual well-being. These dimensions are interconnected, shaping our overall health and fulfilment. If any one of these dimensions is neglected over time, it will adversely affect one's health, well-being, and quality of life. This chapter extensively explores environmental wellness covering issues like sustainability, harmonious relationship, and resource conservation.

Eight dimensions for Health

Physical wellbeing encompasses various aspects, such as physical health, sleep, exercise, nutrition, sexual health, and responsible substance use. It involves proactive healthcare management to prevent illness and injury,

emphasizing the importance of advocating for one's body and making informed choices to maintain overall health and vitality.

Occupational Wellbeing involves participating in activities that provide meaning and purpose and reflect personal values, interests, and beliefs, including employment i.e. personal satisfaction in job/career.

Spiritual wellbeing entails discovering beliefs, principles, and values that provide life with meaning and purpose. This connection between spirituality and wellbeing is individualized, with unique expressions for each person. It may encompass religious engagement, exploration of diverse faiths, meditation, nature immersion, gratitude cultivation, or deep conversations about beliefs and life's profound questions with friends, all contributing to one's spiritual fulfilments.

Intellectual wellbeing entails nurturing curiosity, fostering critical thinking, and embracing lifelong learning. Seeking diverse opportunities to expand one's knowledge, both in and out of formal education, is vital for sustaining and enhancing intellectual wellness.

Financial wellbeing involves gaining financial literacy, being informed, and managing money effectively, not necessarily achieving wealth. It encompasses present and future financial planning while living within one's means. To enhance financial literacy, consider creating a budget, opening a savings account, and educating yourself on investing through various resources, including articles, books, and YouTube videos etc.

Social wellbeing entails nurturing healthy relationships, fostering inclusivity, and engaging in open communication. It is having a sense of belonging while valuing diversity. It involves open communication, boundary setting, and mutual respect regardless of our differences.

Emotional wellbeing involves embracing diverse emotions constructively. Staying in tune with your emotions helps you manage stress and foster your mental health so you can bounce back from challenging moments and maintain balance.

Environmental wellbeing / Environmental wellness

Environmental wellness is a comprehensive approach to well-being that encompasses physical, mental, and social aspects while emphasizing our

deep interconnection with the natural world. It acknowledges the critical role the environment plays in human health and ecological balance. Threats like pollution, chemical exposure, climate change, and UV radiation underscore the need for conscious environmental stewardship.

To achieve environmental wellness, individuals must engage in responsible and sustainable interactions with the Earth. This involves safeguarding food and water supplies, preventing diseases, addressing societal violence, and mitigating environmental hazards. Aligning with the rhythms of nature has been a timeless pursuit for human flourishing, and contemporary practices labelled "environmental wellness" continue this tradition.

Embracing environmental wellness means adopting lifestyles that prioritize nature conservation and sustainable living. By nurturing a harmonious relationship with the environment, we not only enhance our own well-being but also contribute to the survival of countless species and the long-term health of our planet. Recognizing the profound connection between personal wellness and environmental health reinforces the urgency of taking proactive steps to protect and preserve the world that sustains us.

Environmental Wellness Begins with one's Awareness

Benefitting from the therapeutic qualities of the environment begins with cultivating awareness of one's surroundings, regardless of the initial setting. This encompasses spaces such as your home, office, yard, and the streets. Environmental wellness entails feeling physically secure within clean and safe environments while having access to clean air, food, and water. This concept extends to both the microenvironment, comprising the places where we reside, work, and study, and the macro-environment, which encompasses our communities, nations, and the planet as a whole.

Environmental conditions are intimately intertwined with the social determinants of health, which are the circumstances within the various environments individuals inhabit. These determinants, including birthplace, living conditions, work environments, recreational spaces, and more, significantly impact health and overall well-being. Environmental

and social determinants are complexly interconnected and challenging to measure in isolation.

The physical environment plays a pivotal role in influencing stress levels, fatigue, and the availability of vital social relationships, particularly for those with mental health conditions. To foster recovery and alleviate symptoms, it is crucial to reduce stressors and enhance access to social support networks. In essence, recognizing the symbiotic relationship between environmental and social determinants is paramount to promoting holistic well-being and improving the overall quality of life.

Attention to the Inside and Outside Environments such as home, work, and nature, influence health and well-being. Research suggests that spending time in nature is an underappreciated health promotion tactic. Nature excursions, like visiting parks or forests, reduce stress, boost mood, and enhance overall well-being. These natural environments play a vital role in promoting environmental wellness.

Nature's impact on health

Well-being in the environment and nature's impact on health are interconnected concepts that highlight the profound relationship between human health and the natural world. It's essential for us to nurture this connection.

1. Mental Health Benefits of Nature:

Stress Reduction: Spending time in natural environments, such as parks, forests, or near bodies of water, has been shown to reduce stress and anxiety. The sights and sounds of nature can promote relaxation and lower cortisol levels.

Improved Mood: Nature exposure can enhance mood, increase feelings of happiness, and reduce symptoms of depression. The concept of "forest bathing" or shinrin-yoku in Japanese culture emphasizes the therapeutic effects of simply being in the presence of trees.

Enhanced Cognitive Function: Natural settings can boost cognitive function and creativity. People often find it easier to concentrate and problem-solve after spending time outdoors.

2. Physical Health Benefits of Nature:

Physical Activity: Natural environments encourage physical activity, such as hiking, biking, or simply walking. This can lead to better cardiovascular health, weight management, and overall fitness.

Vitamin D Production: Exposure to natural sunlight is essential for the production of vitamin D, which is crucial for bone health, immune function, and overall well-being.

Better Air Quality: Many natural settings have cleaner air compared to urban areas, which can reduce the risk of respiratory problems and allergies.

3. Social and Community Benefits:

Social Interaction: Nature can provide a setting for social interaction and community bonding, such as picnics, group hikes, or outdoor sports. These activities promote social well-being and a sense of belonging.

Community Resilience: Natural spaces, including urban green spaces, contribute to community resilience by providing areas for relaxation, recreation, and disaster mitigation. They can serve as gathering places during emergencies.

4. Restorative Properties of Nature:

Attention Restoration: Natural environments allow the brain to recover from mental fatigue and overstimulation, leading to increased attention and productivity.

Emotional Restoration: Nature offers a respite from the demands of daily life, allowing individuals to reconnect with themselves and find emotional balance.

5. Biodiversity and Health:

Ecosystem Services: Biodiverse ecosystems provide essential services like clean water, pollination of crops, and disease regulation. Human health depends on these services.

Zoonotic Diseases: Understanding the interactions between human health and biodiversity is crucial for preventing zoonotic diseases, which can originate from wildlife and affect humans.

6. Conservation and Well-being:

Conservation Efforts: Protecting and preserving natural environments is not only essential for biodiversity but also for human well-being. Conservation initiatives can help ensure access to the health benefits of nature for future generations.

Transforming Environmental Wellness for a Sustainable Future

Environmental wellness plays a crucial role in our overall well-being, especially in today's world. Our physical spaces are even more impactful now, as many of us work and live in the same space. All of these environments have the potential to positively or negatively impact overall health and well-being the condition of our physical surroundings significantly impacts our mental and emotional state. A cluttered and chaotic environment can lead to stress and hinder our ability to lead happy, healthy lives. Therefore, maintaining outer order is vital for inner calm. Moreover, being mindful of local and global environmental issues demonstrates a commitment to the well-being of our planet and future generations.

To promote environmental wellness,

1. One can spend time outdoors in nature to rejuvenate their mind and spirit.
2. Additionally, practicing eco-friendly habits like reducing, reusing, recycling, and minimizing one's environmental footprint contribute to a healthier planet and personal well-being.
3. Using sustainable transportation options like walking, biking, or carpooling not only benefits the environment but also promotes physical health.
4. Creating safe, abuse-free, and organized spaces at home and work fosters emotional stability.
5. Access to fresh food, clean water, and nature further enhances environmental wellness by ensuring physical health.

6. To promote environmental responsibility, opt for sustainable transportation, like biking, walking, or public transit.
7. Embrace recycling, composting, and maintain a garden for eco-friendly practices.
8. Prioritize natural cleaning products,
9. Declutter spaces for efficiency,
10. Being concerned about impacts on your local, national, and world climate.
11. Conserve energy.
12. Living and working in spaces that are free of abuse and hostility.
13. Keeping your home and workspaces clean and organized.

In conclusion, a harmonious and sustainable environment is a cornerstone of a happy and healthy life. The well-being of individuals and communities is intricately linked to the environment and nature. Recognizing and nurturing this connection can lead to improved mental, physical, and social health, as well as contribute to the conservation of our planet's natural resources. Foster an understanding of Earth's natural resources and their significance in sustainability efforts for a healthier planet. Incorporating nature into our daily lives, advocating for green spaces in urban planning, and supporting conservation efforts are all ways to promote well-being in the environment and harness nature's positive impact on health.

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Chapter - 4

Groundwater Depletion
The End of Life

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Intoduction

Groundwater is a very valuable resource for human beings throughout the world. It is the main and sometimes the only source of water where rivers or lakes or any other means of potable water is scarce or unavailable. It is a source of drinking water for nearly 40-45% of the world population and nearly 90-95% of the rural population and it provides billions of gallons of water per day for drinking and agricultural purposes. Groundwater irrigation is critical for India's food security, and its importance will likely only increase over the coming decades due to climate change.Ground water depletion is a term defined as long term water level decline caused by sustained ground water pumping (extraction). Many areas in the world are experiencing groundwater depletion today.

It is important to understand how groundwater is formed. Astronomically and geologically, groundwater is a part of the big bang and was formed after a few billion years of the big bang but before the formation of earth. It was always roaming around in the form of vapor. As the earth and other planets started taking shape, these water vapors started getting trapped. As the earth and other planets cooled down, the vapors crystalized and got trapped under the crust in aquifers.

Geologically, the groundwater is rainwater. This rainwater in the form of rain, snow etc. seeps through the land from various cavities and

orifices and gets accumulated in aquifers where it gets trapped and stays there until extracted. Sometime when it finds ways, it comes back on the surface in lakes, streams, marshes and sometimes as fountains.

About 22% of Earth's total fresh water comes from groundwater and it plays a very critical hydrological, geological and biological role on the continents. Soil and rock layers in groundwater recharge zones (any entry point where water enters into aquifers) reduce flooding by absorbing excess run offs after heavy rainfall. Aquifers stores water through dry seasons and groundwater flow carries beneath arid deserts and semi-arid grasslands. It replenishes streams, culverts, lakes etc. on the land surface and is life giving in places which receive less or no rainfall. Flowing groundwater interacts with rocks and minerals in aquifers and carries biological nutrients which supports a lot of plants and animals (ecosystem) living in the area.

Almost all the freshwater that is readily available for human use comes from aquifers.

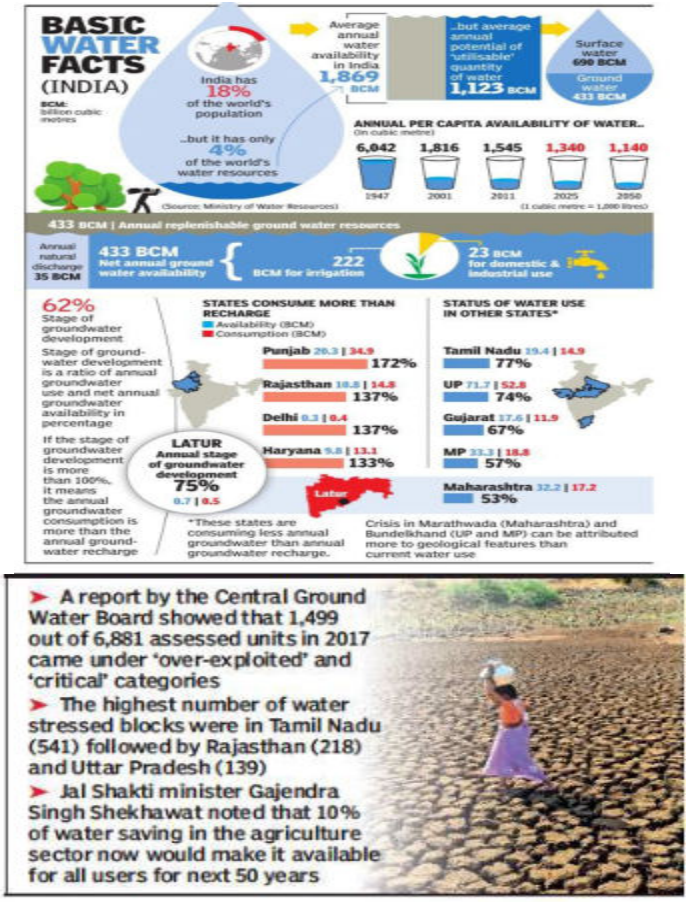
Although there is a huge mass of freshwater on the surface of the earth, it is in frozen form on North pole and South pole and is unusable for human population.

For thousand of years, human beings have used groundwater from springs, shallows and wells for drinking and for agricultural purposes. Today, the human need far exceeds the surface water supplies and earth's rapidly growing population relies heavily on extraction of underground water. This extraction has been done through pumps for the last 150 years all over the world.

Now in today's context , this extraction can be compared to a bank operation. More money is being taken out than the money going into the bank and hence the bank is destined to go bankrupt. Similarly, more water is being extracted than the rate of replenishment and very soon the underground water is likely to be exhausted very soon.

Facts:

- ✓ According to the estimates, 85% of rural and 50% of urban population in India is dependent on groundwater.
- ✓ India tops the list of top 10 groundwater extracting countries (approximately 260 billion cubic meters).
- ✓ A report from World Resource Institute, India is one of the 17 countries facing extremely high-water stress.
- ✓ More than 1000 blocks in India have become water stressed.
- ✓ As per CWMI (Composite Water Management Index) 2018 by NITI AAYOG, the water demand will exceed supply by 2030.
- ✓ It is estimated that between 2002 and 2016, groundwater depleted at the rate of 10-25 m/year.
- ✓ It is estimated that by 2030, 40% of India population will have no access to drinking water.
- ✓ Studies have suggested that with the falling of quantity of groundwater, the quality has gone down too.



Source: https://www.civilsdaily.com/burning-issue-groundwater-depletion-in-india/

Main causes of Water Depletion:

Some of the main reasons of such pathetic conditions of groundwater depletion are as follows:

- **Estimation of groundwater resources:**
  There is an absolute lack of data for estimation of groundwater resources.

- **Crop pricing and water intensive crops:**
  The primary cause of groundwater depletion is over exploitation for agricultural purposes. Add to it, decisions such as cropping patterns and cropping intensity are taken independent of groundwater availability in the area. Minimum support price (MSP) is also available for water intensive crops leading to widespread cultivation of such crops.

- **Energy Subsidies:**
  The practice of providing energy subsidy for agriculture has played a major role in groundwater depletion as farmers don't care how much water they waste.

- **Lack of regulations:**
  Lack of regulations and further lack of implementation is one of the major reasons of groundwater depletion in India.

- **Lack of local management and Education:**
  Lack of education among population and specially farmers is one of the root causes of groundwater depletion. Also, there are no local management to ensure strict adherence to guidelines for usage of groundwater.

Some of the major effect of ground water depletion are as follows:

- **Lowering of water table:**
  One of the severe consequences of groundwater depletion is lowering of water table. Water table is defined as the depth of water available below the surface of the Earth. The best situation is where water table is at the minimum depth from the surface as the extraction is simple and needs least energy and this water is also able to feed the various springs, wells, rivulets and even rivers. Today, due to heavy extractions of ground water the water table has been going down. In some places, it has reached so low that it has become almost impossible to extract ground water. In other places, it needs to be extracted from larger pumps which need more electricity and fuels. Also, the water at the bottom of the

aquifer is impure and outright unusable for human consumption or agricultural purposes.

- **Reduction of water in streams, wells and lakes:**
  All wells depend upon groundwater and water table and so do most of the streams and lakes. Groundwater contributes to the streams and lakes in the most physiographic and climatic settings. The proportion of groundwater that flows into the streams and into the lakes varies according to the region's geography, geology and climate. Groundwater extraction affects the way water moves between aquifer and the streams / lakes. As the water table goes down, so does the depth of the well and also the quantity that flows into the streams and lakes. This affects the wetland vegetation in a very severe way. The overall ecological effect is catastrophic.

- **Land Subsidence:**
  Groundwater depletion causes massive land subsidence. In most of the aquifers the water is trapped in such a way that it yields upwards pressure which keep the rocks and soil above in balance. As the groundwater is depleted, the upward pressure is either diminished or become altogether absent and subsequently the said upper rocks and soil collapse. The subsidence mostly depends upon the size of aquifer, which are usually very large.

- **Increased cost of procurement of water:**
  As said earlier, as the water table goes down it needs more power and hence more energy; Electricity or fuel, which consequently is directly proportionate to the lowering of water table and the comes a stage wherein pulling the water out of the aquifer becomes prohibitively expensive.

- **Deterioration of water quality:**
  Not all groundwater is fresh. Saline water also seeps in through ocean beds and ocean corners whenever it gets an aqueduct and accumulate in the aquifers. Saline water, being heavier, settles at the bottom. In the normal set of circumstances, the fresh water

comes out when extracted: but when the water table goes too low, it is saline water what comes out which is absolutely useless either for consumption or agriculture.

How to control groundwater depletion:

- ✓ There should be regular assessment of groundwater levels to ensure that adequate and correct data is available for a specific region to help formulate policies and their implementation.
- ✓ Land usage pattern should be assessed and the proportion of agriculture land falling under overly exploited units should be identified. This will lead to identify the suitable crop for the unit.
- ✓ The agriculture power pricing policy needs to be revamped thoroughly.
- ✓ Replenishment of groundwater depletion where it has been overused should be taken on war footing.
- ✓ Water meters should be installed to avoid overuse and / or misuse of groundwater.
- ✓ Groundwater pollution should be checked immediately and a policy with severe punishment for such act should be implemented.
- ✓ There should be synergy between central, state and local governments for optimum benefits.
- ✓ If water is brought under concurrent list of Indian constitution, it can help in the development of a comprehensive action plan.
- ✓ Special plans need to be devised for upkeep, maintenance and restoration of water bodies.

The government of late has become very conscious of the situation of groundwater and has come up with quite a few initiatives.

- ❖ Formulation of National water policy (2012): This policy advocates for the:
  1. Rainwater harvesting
  2. Direct use of rainfall
  3. Conservation of water bodies through community participation.
- ❖ Creation of new ministry of Jal Shakti.

- ❖ Atal Bhujal Yojna for sustainable management of groundwater resources in states like Gujrat, Haryana, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan and Uttar Pradesh.
- ❖ Mass awareness programs.
- ❖ Incentivizing good practices in water conservation.

Conclusion:

Groundwater depletion is becoming a glaring and threatening issue by the day. It is high time the causes are paid attention to and appropriate measures are taken in timely manner to avoid catastrophe that is looming over not very distant future. With government initiatives and community participation, the groundwater depletion can be averted. All it needs it dedicated minds and efforts.

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Chapter - 5

Effect of Climate Change on Aquatic Fauna

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Abstract: Climate Change is the transformation of climate characterized by the changes in usual climate of the planet. The exploitation of nature for decades due to human activities like burning of fossil fuels, cutting down forests and farming livestock are increasingly influencing the climate and other earth's temperature. The burning of fossil fuels generates greenhouse gases in the atmosphere. The environment has been polluted with an increases greenhouse gases. Consequently, we are facing the threats of global warming and other climate changes. Changes in the climate conditions cause rise in temperature, melting of polar ice, rising sea level, change in ocean current system and acidification of sea water. Climate change increases the temperature of water will alter fundamental ecological processes and the geographic distribution of aquatic species. Aquatic animals are prone to the effects of climate change globally. Aquatic animals are very sensitive to the change in the temperature in their external environment where they live. When the external environmental temperature goes beyond the tolerance limit of these organisms, they will go for migration. Global warming is playing a significant role in aquatic animal species extinctions. Production of marine fishes, aquatic animal species composition and ecosystem productivity are adversely affected by climate change.

Keywords: Climate change, Global warming, temperature, Aquatic Fauna.

Introduction: The climate of a region is its typical or average weather. Climate change is a change in the average conditions such as-temperature and rainfall in a region over a long period of time. Climate change refers to long shifts in temperature and weather pattern, such shifts can be natural, due to change in the sun's activity or long volcanic eruptions and human induced. Human driven changes in land use and land cover such as deforestation, urbanization, and shifts in vegetation patterns also alter the climate change, resulting in changes to the reflectivity of earth surface , emission from burning forests, urban heat island effects and changes in the natural water cycle.[1] For the last few decades, climate change, food security and their complex interaction have become a global issue. But the science 1800s human activities have been the main driver of climate change, primarily due to the burning of fossil fuels like coal. Oil, and gas. Burning fossil fuels generates greenhouse gas emissions that increase the temperature of earth and cause global warming. The level of greenhouse gases in the atmosphere is increasing day by day. Consequently, we are facing the threats of global warming and other climate changes like cyclone, drought, flood, etc. Change in the climatic conditions may be limited to a specific region or occurs across the whole earth. These include warming temperature and change in precipitation. But, it affecting all the ecosystems including the aquatic ones. Aquatic organisms are very vulnerable to climate change because the average temperature of both air and water are changing simultaneously. It directly acts upon the physiological behavior and growth pattern of organisms, subsequently decrease reproductive capacity and finally cause mortality.

Global warming: Global warming may be defined as the sharp increase in global temperature of the outer atmosphere of earth, due to the increase in quantity of gases known as greenhouse gases. Global warming has become a major environmental concern all over the world. Over the last 1800s years or so the global temperature has risen by only 4^{0c}. The rate of global warming for the past quarter century was greater than any previous period since 1880. Current estimates of global warming during this

century suggest a rise in average global temperature of anywhere between 2^{0c} and 6^{0c}. Causes of global warming: Global warming is mainly due to the increase in the concentration of carbon dioxide (CO_2), methane (CH_4), chlorofluorocarbon (CFC), nitrous oxide (N_2O) and ozone (O_3)in the atmosphere . These are known as greenhouse gases because these gases behave like a glass which allows the sunlight to pass through, but traps the outgoing thermal radiation.

Greenhouse effect: The term greenhouse effect is formulated to indicate a heat trapping process caused by greenhouse gases. Thus, the greenhouse gases form an insulative blanket over the earth's surface that permits short wavelength ultra violet and visible light from the sun to pass through, but retards loss of heat as longer – wavelength infrared radiation. This infrared energy absorbed by CO_2 and other gases in now closer to the earth 's surface resulting in warming of lower layers of the atmosphere. This warming of the earth's surface goes on increasing with the simultaneous increase in CO_2 in the atmosphere. This type of warming of the earth's surface due to increasing amount of greenhouse gases in the atmosphere is called Green-house effect.[2]

Causes of climate change: The factors that can cause a change in the atmospheric system or climate regime are called climate forcing or forcing mechanisms. But overwhelming evidence exists that anthropogenic activities are the major reason behind this dreadful condition. These are described below-

1. Fossil fuel burning: Fossil fuel burning is one of the most important sources of climate change as fossil fuel contain carbon for many years, they can release back CO_2 into the air. This is one of the direct causes of carbon emission in the air, which can cause all sorts of environmental problems including global warming.

2. Aerosols: Aerosols also represent a big problem for the climate today. Aerosols are very small naturally occurring particles in the atmosphere. Previously the number of aerosols in the atmosphere was very less ,but now level of aerosols is increasing.

3. **Livestock farming:** Through livestock farming, methane gas is emitted in to the atmosphere. As we know, CH_4 is a greenhouse gas, so capable of

trapping a hung amount of heat from the sun. In that way, they can contribute to global warming and climate change.

4. Use of fertilizers: Use of fertilizers in both agricultural and aquacultural farmland can increase the availability of food source greatly to us. To meet up the growing demand for food, the use of fertilizers have increased rapidly. Nitrous oxide, which is responsible for a steady increase in the earth's surface temperature[3].

Consequences of climate change: As a result of this continuous increases in levels of greenhouse gases, earth has been suffering from fever. Climate change has become one of the prime issues threatening the sustainability of world's environment. Besides environment, climate change has also impacted on livability, health and economy of the globe[4].

1. A rise in global temperature causes sea levels to rise as polar ice caps and glaciers begin to melt, along with thermal expansion of water.

2. More droughts and floods.

3. More terrible storms.

4. Many more hot days.

5. More diseases like malaria and dengue.

6. Impacts on ecosystem would change the crop production potential of a region.

Effect of climate change on aquatic fauna: Climate change in the aquatic system mainly occurs through sea level and temperature rise, change in monsoon patterns, extreme weather events and water stress having both direct and indirect impact on aquatic animals Climate change impacts on inland aquatic ecosystem will range from direct effect of the rise in temperature and CO_2.

Crustaceans- The increase in the CO_2 amount which is among the causes of climate change results in the decline of sea water's P^H, and thus the acidification of sea water. This case negatively affects the crustaceans. The outer skeletons of crustaceans consist of aragonite a common form of calcium carbonate, and it can dissolve in acidic sea water. Extinction of

these small crustaceans found at the bottom of the nutrition chain can change the entire sea ecosystem[5].

Coral reefs – Coral reefs are very important for oceans as these reefs are the places where the carbon cycle take place. Coral reefs constitute a natural set against big ocean waves and tidal waves and serve for the protection of coastal lines. The fish and other crustaceans they hold are a significant source of food and mainstay. Coral reefs are the places where mainstay living beings come to reproduce by these reefs. Corals grow as long as they are not broken because of external influences. However, the changes in the temperature and acidity rates kill and solidify the corals.

Fish- A fish population can be tolerant temperature changes in the area where it is distributed in a certain time interval. If these changes are within a certain temperature boundary and slow, it generally causes migration of fish. When the external environment temperature goes beyond the tolerance limit of these organisms, they will go for migration to the place where their internal system allows them to regain their internal homeostasis. This procedure is termed as behavioral thermoregulation. Temperature takes important physiological phenomena such as feeding, respiration, osmoregulation, growth, and reproduction under control. The fish of *Thallossoma pavo* species can now be observed in the sea of *marmara* and that its distribution has shifted towards the north from the south of the Mediterranean sea is explained within the impact of global warming. The increase in the sea water temperature affects the transition and entrance of thermophilic fish species into the black sea.

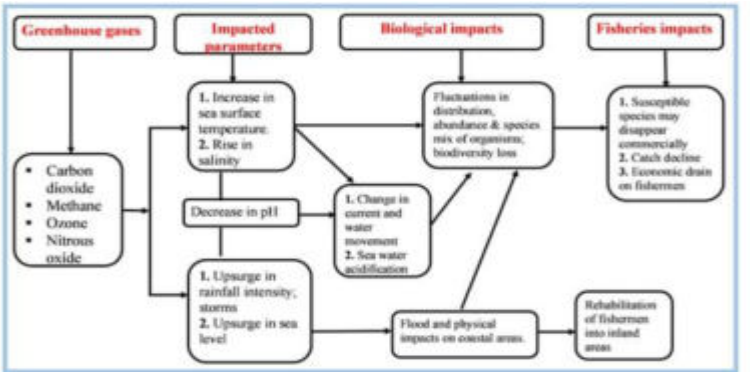

Figure 2: Expected impact of climate change on marine fisheries,

(Vivekanadan, 2006)

Turtles- Another living being that is under threat due to climate change is the turtle. For the majority of living being, the sex of the juveniles are determined by the chromosomes, in some living beings such as the tortoises, the environmental conditions determine whether the juvenile will be male or female. Among the environmental factors that affect physiological characters such as the sex ratio of juveniles, incubation period, growth activity and winter sleep, the most determinant factors is temperature of the habitat. For species the juvenile's sex of which is determined by the habitat temperature during incubation period. Turtles and alligators, are among the species that will perhaps be most drastically influenced by global warming. The increase in temperature will distort the sex rate in future generations and probably cause the emergence of groups of females in turtle and only males in alligators that will definitely not be able to continue breeding. The digestion, growth rates, activities and reproduction rates of such animals such as alligators and turtles are also affected negatively by the increase in temperature[6].

Marine Mammals- Climate change is now known to be affecting the oceans. It widely anticipated that impacts on marine mammals will be mediated primarily via changes in prey distribution and abundance and that the more mobile species may be able to respond to this to some

extent. However, the extent of this adaptability is largely unknown. Meanwhile, within the last few years direct observations have been made of several marine mammals' populations that illustrate reactions to climate change. Certain species and populations may be especially vulnerable, including those with a limited habitat, such as the narwhals Monodon monoceros, bowhead Balaena mysticetus and beluga Delphinapterus leucas whales and polar bears Ursus maritimus[7]. Polar bears are the living beings that will be mostly affected by the decrease in sea ice. The decreasing of sea ice, which allows them to feed at remote distances, due to global warming will cause the polar bears not to feed properly. Polar bears can still carry on their lives like that but the fat rate in their bodies will decrease because of malnutrition. This case means extinction for polar bears which require a certain amount of fat rate in their bodies to reproduce. In the next 50-100 years, a significant decrease in sea glaciers is expected due to global temperature change. As a result of loss and decreasing of the habitat quality, a decrease of 30% is estimated in the polar bear population[8].

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Chapter - 6

Climate Change: Consequences and Mitigation

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Abstract- Climate change refers to the long-term changes in the climate that occur over decades, centuries or longer. It is caused by rapidly increasing greenhouse gases in the Earth's atmosphere due primarily to burning fossil fuels (e.g., coal, oil, and natural gas). Weather, in contrast to climate, is the daily experience of atmospheric conditions such as temperature, precipitation, humidity, wind, etc. More frequent and intense drought, storms, heat waves, rising sea levels, melting glaciers and warming oceans can directly harm animals, destroy the places they live, and wreak havoc on people's livelihoods and communities. As climate change worsens, dangerous weather events are becoming more frequent or severe. Sea levels are rising and oceans are becoming warmer. Longer, more intense droughts threaten crops, wildlife and freshwater supplies. From polar bears in the Arctic to marine turtles off the coast of Africa, our planet’s diversity of life is at risk from the changing climate. Climate change poses a fundamental threat to the places, species and people’s livelihoods. WWF works to protect. To adequately address this crisis we must urgently reduce carbon pollution and prepare for the consequences of global warming, which we are already experiencing. Climate change has been recognized as the foremost environmental problem of the twenty-first century and has been a subject of considerable debate and controversy. It is predicted to lead to adverse, irreversible impacts on the earth and the ecosystem as a whole.

Keywords: Climate Change, WWF, Ecosystem

INTRODUCTION

Climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. Climate System: The climate system is the highly complex system consisting of five major components: the atmosphere, the hydrosphere, the cryosphere, the lithosphere and the biosphere, and the interactions between them. The climate system evolves in time under the influence of its own internal dynamics and because of external forcings such as volcanic eruptions, solar variations and anthropogenic forcings such as the changing composition of the atmosphere and land use change. Earth is a constantly changing planet since its formation around 4.5 billion years ago and hence, its climate is also witnessing changes from time to time. Weather and climate have a profound influence on life on earth. Over time, the earth has developed a climate that nurtures the life system and the planet is flourished with a whole lot of flora, fauna and human beings. The survival of human beings is solely dependent on the conducive climate that the earth provides. However, human intervention has changed the climate system adversely. Climate change as science has received unprecedented attention from both scientific institutions and academia. Climate change is a global issue that requires worldwide cooperation and negotiations for developing the necessary actions to combat its effects. This requires the integration of adaptation into existing policies and processes, taking into account the broader policy objectives and wider costs and benefits.

GLOBAL CLIMATE CHANGE: Atmosphere and Climate (structure and composition)

Scientists found no existence of atmosphere at the time when earth came to existence about 4.5 billion years ago. Then, natural volcanic activity was a continuous phenomenon and the Earth existed in the form of hot gaseous mass having surface temperature more than 80000 C. The gases captured inside the magma slowly released. Major gases emitted then were carbon dioxide (CO_2), water vapour and ammonia and the atmosphere were devoid of oxygen i.e., reducing atmosphere. Later, as Earth started to cool down, cloud started to form and as a result, the Earth

experienced rain and water bodies like ocean basins got filled up. CO_2 present in the atmosphere dissolved with water and carbonic acid so formed poured down on the Earth and that's how carbonate rock would have formed. Scientists have given many theories behind the formation of Earth's atmosphere and life in particular. It was water and presence of sunlight that has made possible the formation of oxygen over geological time scale and so to the life on the Earth. On planet Earth, life became possible as a result of having blanket of gases called atmosphere which extends up to 9600Km from the Earth's surface. Of course, the gravitational pull of the Earth makes atmosphere inseparable from the mother Earth. As, we move higher in altitude, the density of air declines. Since, atmosphere is made up of gases so it can be compressed. Atmosphere has not only provided the adequate temperature to sustain life but also given other suitable conditions to flourish. More than 97% of the air is concentrated up to 29km from the Earth's surface. In spite of lesser density to that of land (lithosphere) or water (hydrosphere), air exerts pressure on the surface which is called as atmospheric pressure. It is this blanket of gases which provides us O_2 to breath and CO_2 to plants to photosynthesize and much more. Ozone made life possible by absorbing ultraviolet (UV) radiation. Over geographical time scale i.e., millions of years the atmosphere got thermally stratified which has impacted its composition and vice-versa. Thermal Stratification of Earth's Atmosphere Earth's atmospheric temperature varies with height from the ground. **The atmosphere can be divided into five layers.** Starting from the Earth's surface, these are troposphere, stratosphere, mesosphere, thermosphere and exosphere.

Troposphere: The troposphere is the layer nearest to Earth's surface. The height of the troposphere varies with location, being higher over warmer areas and lower over colder areas. The boundary where troposphere ends is called the tropopause. It varies with location ie., from 5-6 km at colder areas like pole and 18 km at the warmer area like equator. This layer has the highest density in comparison to the rest and contains 80% of the atmospheric mass. Nitrogen is predominant (78% by volume) followed by oxygen (20.9%), argon (0.93% by volume), carbon dioxide (0.04%), etc. This layer is very turbulent and has strong vertical movement of air. Due to this vertical movement of air mass, air pollution gets diluted from the

point of its origin and settles to the ground as a result of precipitation. All weather phenomena occur in this layer. As you go up in the troposphere, atmospheric temperature decline at the rate of 6.50 C per km. As we move up the air mass get colder in this layer and so it becomes heavier and tries to push down air mass beneath which is warmer and that's how creates the vertical movement of air mass.

Stratosphere: The Stratosphere is the layer next to the troposphere. "Strat" means layer and this layer of our atmosphere has its own set of layers. This layer has increasing temperature trend with height and air mass becomes stable. The boundary where stratosphere ends is called the stratopause. This layer ends at about 50 km above ground. Ozone (O_3) is predominant in the stratosphere. O_3 absorbs ultraviolet radiation from the sun that causes heating of air and so temperature increases with height and temperature inversion got noticed. The air mass in this layer is much drier and much less dense than troposphere.

Mesosphere: The layer next to stratosphere is called mesosphere. It starts from about 50 km and extends until 85 km from the ground. The upper most part of the mesosphere is called the mesopause. The temperature in this layer decreases with height like troposphere. This layer has nitrogen (N_2) and oxygen (O_2) but the concentration are 1000 times less and with little water vapor present, there occurs no weather phenomena. The mesopause becomes the coldest part of Earth's atmosphere.

Thermosphere (Ionosphere): The thermosphere is the uppermost layer of the atmosphere. In this layer the temperature increases with height because it is being directly heated by the sun. It extends from about 90 km to between 500 and 1,000 km. It is so close to the Sun that temperatures can be as high as 1,5000 C and as a result ionization occurs. Ionization is the process of conversion of atoms or molecules into ions in the presence of solar radiation. This is the layer where horizontal layers get formed and as a result radio wave gets reflected from this layer. This is the layer from where the aurorae occur too. Aurorae are the natural light displaying phenomena in the Earth's sky called as, northern polar lights i.e., in Arctic as Aurora Borealis and in Antarctic, southern lights as Aurora Australis.

Exosphere: The last layer, the exosphere, the last-layer, is quite thin and is where the atmosphere mingles into the outer space. It consists of very widely dispersed particles of hydrogen and helium. Atmospheric Pressure as we move higher in altitude, atmospheric pressure declines but rate of decline reduces with height.

Greenhouse gases (GHGs) are gases that absorb reradiated (long wave) radiation from the earth and emit it back to the atmosphere. Increase in GHGs in atmosphere enhances trapping of radiation and so add on to warming of the Earth and vice versa. CO_2, CH_4, N_2O, water vapour, Black carbon (BC) etc. are responsible for warming of the Earth. Concentrations of GHGs are commonly given in percentages as well as mixing ratios of gases to total air volume (v/v), such as parts per trillion (ppt), parts per billion (ppb), and parts per million (ppm). Potential sources of GHGs are burning of fossil fuel. Fossil fuel is any hydrogen and carbon rich substance that was created by the decomposition of prehistoric plants and animals that can be burned to produce heat or energy. This includes coal, petroleum, and natural gas products. GHGs like CO_2, CH_4, etc. whose percentages vary diurnally, seasonally, and annually, interact with incoming solar radiation (insolation) and infrared radiation which is also called long wave radiation re-emitted from the earth which affect the energy balance. Even though, the GHG concentration is in ppm levels, they can significantly alter the global energy balance and temperature over a period of time. The CO_2 concentration, in 2009, was about 385ppm, and is increasing at an average global rate of 1.9ppm per annum. Presently, the carbon dioxide concentration is about 410 ppm. a) Carbon dioxide (CO_2) CO_2 is the most dominant GHG in the atmosphere (excluding water vapor). In its natural occurrence it helps keep the earth at a comfortable and life sustaining temperature. However, it is also registered to be the main culprit behind global warming. Anthropogenic activities like burning of fossil fuels, deforestation, biomass-burning and cement production are notable sources of CO_2 production. Natural sources include respiration and volcanic eruptions. CO_2 is removed predominantly from the ecosystem as a result of photosynthesis by plants and through oceanic absorption. From year 1957, atmospheric CO_2 is measured at the South Pole and 1958 at Mauna Loa, Hawaii. Methane (CH_4) CH_4 is more commonly known as swamp gas. This is the second most abundant greenhouse gas and it is 21

times more efficient at warming than CO_2. CO_2 is much more abundant in the atmosphere and remains in the atmosphere for a much longer period of time than methane and therefore has a larger overall warming effect in the atmosphere than methane does. Methane is produced anthropogenically by landfills, ruminant livestock, biomass burning and natural gas systems. Some natural sources are wetlands and termites. Methane is the largest component of natural gas, which is used as a fuel source once the contaminants are removed. The atmospheric lifespan of a molecule of methane is estimated to be around 12 years. Until industrial revolution, CH_4 concentration recorded was 730 ppb but it has increased more than three times in the last decade, 1774 ppb. Total annual emission of CH4 has been estimated as 600 Tg, 60% of the total share is by anthropogenic activities like agriculture, burning of fossil fuel and from waste. CH_4 has a mean absorption band at 7.7µm and has residence time of 9 to 15 years. c) Nitrous oxide (N_2O) Nitrogen being dominant in share by volume, formation of nitrous oxide (N_2O) also known as laughing gas is one of the naturally occurring greenhouse gases (GHGs) in the atmosphere. This is 200 times more powerful GHG than a unit of CO_2 in terms of global warming potential calculated over a period of 100 years. In recent past, its concentration has increased from 275ppb to 320ppb. Ocean and wet forest soils (9 Tg/year) are two predominant natural sources of nitrous oxide emission followed by anthropogenic i.e., deforestation and nitrogenous fertilizer (6Tg/year) to atmosphere. Nitrous oxide has an absorption band at 7.8µm and 8.6 µm. d) Halocarbons (CFCs) Halocarbons are the substances responsible for the hole in the ozone layer. Though they have been heavily regulated, they are still responsible for some amount of global warming. Halocarbons are mostly man-made gases consisting of both carbon and at least one of the halogens (fluorine, chlorine, iodine, and bromine). The majority of them fall into the category of Chlorofluorocarbons or CFCs. It is carbon-to-fluorine bonds in halocarbons that oscillate and hence absorb at 9µm. It has ability to destroy stratospheric ozone, but they are also very strong greenhouse gases. On average, they are thousands of times more efficient at warming than CO_2. Fortunately, their concentrations are very small, so their powerful greenhouse effect is limited. Their atmospheric lifespan can range from 1 to 50,000 years. The sources include refrigerants and

propellants. Most of these gases have been highly regulated by the Montreal Protocol (1989) and the vast majority of them are decreasing. Though emissions of CFC-12 have almost stopped, it is such a long-lived gas that it is still responsible for some global warming as well as the ozone hole.

Aerosols: Aerosols are defined as microscopic liquid or solid particles of less than 10 μm diameter, dispersed in the atmosphere. Aerosols are non-uniform in shape and size so equivalent aerodynamic diameter determined by comparing them with perfect spheres having same settling velocity. Aerosols come from volcanoes, dust storms, fires, vegetation, sea spray, burning of fossil fuels and land use. Aerosols live only for days to weeks in comparison to other GHGs in the troposphere. Aerosols are more complicated than the typical greenhouse gas. It can do both the cooling and heating of the atmosphere. They affect the Earth's energy balance in three ways: by enhancing albedo i.e., by reflecting back the incoming solar radiation, by providing cloud condensation nuclei and by more absorption of incoming solar radiation.

SOLAR RADIATION: Solar radiation is radiant energy emitted by the sun from a nuclear fusion (hydrogen into helium) reaction that creates electromagnetic energy. This indicates the surface temperature of Sun as about 5800 K. Sun emits not only in visible range but also UV-rays, infrared ray, X-rays, and even radio waves. Out of these, about half of the radiation is in the visible range only. The other half is mostly in the near-infrared part, with some in the ultraviolet part of the spectrum. UV-rays range from 0.1 to 0.4 μm., visible (VIBGYOR) ranges from 0.4-0.7 μm and infrared ray varies from 0.7 μm -1mm. The surface temperature of the earth is controlled by the balance between the absorbed solar radiation and the emitted infrared radiation. During the past 150 years the amount of CO_2 in the earth's atmosphere has increased from 280 parts per million (ppm) to more than 400 ppm by burning of fossil fuels. Urbanization, deforestation and desertification, agriculture and livestock activity have been categorized as important sectors in emitting CO_2, CH_4, N_2O, particulate matter containing Black Carbon (BC), volatile organic carbon (VOCs), etc.

CAUSES AND CONSEQUENCES

Climate change is caused due to emission of greenhouse gases into the atmosphere. The effects of global warming have been experienced by humans, animals and plants alike. In this block, we will discuss the impact of climate change on agriculture, ocean ecosystem, mountain and hill ecosystems and human health. In this block, the two-way link between climate change and agriculture is discussed. Changing climate will impact agricultural productivity and production. Climate change influences many properties of the ocean, while changes in the ocean also play a central role in regulating weather on local to global scales. The ocean has huge thermal inertia and dynamic capabilities. Being a huge reservoir of heat, the ocean plays as a moderator of climatic variations. It controls the formation of wind and rain. The ocean also traps and stores carbon dioxide (CO_2), thereby preventing an extreme greenhouse effect in the atmosphere. Increased ocean stratification, changes in ocean current regimes and an increase in depleted oxygen zones are now being observed due to climate change. Climate change also impacts the mountain ecosystem. Mountain and hill ecosystems are also characterized by their unique type of vegetation, floral and faunal diversity as well as distinct living habitats. This diversity itself varies with the altitude of mountains, with taller trees being found at lower altitudes giving way to shorter trees, grasslands etc. at higher altitudes. The highest altitudes of mountains are completely devoid of any vegetation. The consequences of climate change on the mountain ecosystem include glacier melting, cloudburst and flash floods, and Glacial Lake Outburst Floods (GLOFs). This block also discusses the impacts of climate change on human health.

CHANGING CLIMATE: Climate variability has ripple effects on crop production, food prices and food security at local and global levels. Production shocks in one part of the world can have immense impact on the food prices and hence food security of various parts of the world due to the market dynamics. Sudden changes in food prices could be particularly harsh on the food security of the poor who spend a large chunk of their income on food. Understanding the nature of changing weather patterns is particularly important for this very reason. “Global surface temperatures have risen by almost a degree in the last century. Sea

levels have risen, while snow and ice cover has dropped significantly. Coral reefs are being destroyed and weather patterns are becoming wilder and less predictable. And the major cause of this climatic mayhem is now clear. It is the work of humans, who are burning ever increasing amounts of fossil fuel and have raised carbon dioxide levels in the atmosphere by 40% in the past 250 years" (McKie, 2013). The plant and animal species specific to a particular region are a reflection of the climate to which they are adapted. Once a change in their natural climate occurs, they tend to migrate to areas having more favourable environment. Species that are less mobile are the worst affected as they have to suffer a loss of their habitat combined with competition from new invading species. This results in such species becoming extinct and as a result there is loss in biodiversity. Changing Precipitation with increase in temperature due to global warming, the air becomes warm, resulting in more evaporation of water from the Earth's surface. Higher evaporation translates to higher precipitation. On average, the world is already getting more precipitation now than it did 100 years ago: 6 percent more in the United States and nearly 2 percent more worldwide (US EPA, 2013). Precipitation is expected to lower in areas near equator and increase in higher latitudes. The changing rainfall pattern can cause the pests and weeds to spread to newer areas.

El Nino and La Nina: El Nino phenomenon occurring in the eastern Pacific Ocean is primarily due to the build-up of warm water in the eastern Pacific Ocean. The warm ocean surface enables the moisture laden winds to form rainstorms. On the other hand, La Nina occurs due to the building up of cool Ocean waters in the eastern Pacific Ocean. The cool ocean surface leads to cooling of the atmosphere leading to lesser evaporation of water and making the air dry. "El Niño and La Niña reflect the two end points of an oscillation in the Pacific Ocean. The cycle is not fully understood, but the times series illustrates that the cycle swings back and forth every 3-7 years. Often, El Niño is followed immediately by La Niña, as if the warm water is sloshing back and forth across the Pacific. The development of El Niño events is linked to the trade winds. El Niño occurs when the trade winds are weaker than normal, and La Niña occurs when they are stronger than normal. Both cycles typically peak in December" (NASA, 2009).

EFFECTS OF CIMATE CHANGE ON AGRICULTURE: Agriculture, livestock and fisheries are highly dependent on specific climatic conditions. Crops need specific conditions to thrive like right kind of soil, specific temperature, and enough water. Changes in climate could make it difficult for us to grow crops and rear livestock in the way and at places; we used to do in the past. Climate change and variability has potential to influence crop geography, crop production and productivity, and exacerbate the risks associated with crop farming activities (Scherr et al. 2012; Venkatramanan and Shah 2019). IPCC Assessment reports reiterate the gravity of climate change impacts on agricultural production and productivity in several agricultural regions of the world, and firmly expressed the vulnerability of developing countries and island and low-lying countries to negative impacts of climate change (IPCC 2014). Impacts from extreme weather events like droughts and floods, heat and cold waves, must be reckon with in the coming decades through devising appropriate climate resilient pathways (Venkatramanan and Shah 2019). "Research has shown that crop yields reduce in response to extreme daytime temperatures particularly around 30°C. High daytime and night time temperature was reported to reduce the growth, yield and quality of rice and wheat crops which are the staple food crops of South Asia" (Venkatramanan and Singh 2009a, b; Venkatramanan and Shah 2019). "Estimated impacts of both historical and future climate change on cereal crop yields shows that yield loss can be up to 35% for rice, 20% for wheat, 50% for sorghum, 13% for barley, and 60% for maize depending on the geographic location, climate scenarios and projected year" (Porter et al. 2014; Khatri-Chhetri et al. 2017). The negative effects of climate change on "food production, food prices and accessibility, consumption and utilization" result in marked effect on "all the dimensions of food security" (Porter et al. 2014). Further, climate change on account of its effects on "access to drinking water, income, health, sanitation, income and food supply chain" exacerbate the food insecurity. FAO (2009) reports that vulnerable and disadvantaged group in particular the small and marginal farmers and food insecure are most likely to be the first affected from climate change (FAO 2009). Monsoon Dependent Agriculture The International Food Policy Research Institute (Gerald C. Nelson, 2009) conducted research to "quantify the climate-change impacts on

agricultural production, consumption, prices and trade". To meet this end, the study employed a "global agricultural supply and demand projection model" and "biophysical crop model" to assess the impact of climate change on five important crops: "rice, wheat, maize, soyabean and groundnut". The results of the study on various aspects of agriculture have been summarized below: Atmosphere and Climate According to the study, while the crop yields in the rainfed region are influenced both by rainfall and increases in temperature, the irrigated crop yields are influenced only by temperature factor. The study further points out that in case of developing countries, while the crop yield declines are found across most crops, the irrigated crops of rice and wheat are more vulnerable to climate change. In the regions like East Asia and Pacific region, higher temperature in fact increases crop acreage as the potential temperature increase provide congenial crop growth environment than the present environmental condition. South Asian region will be affected more by climate change, as the study found yield declines for most of the crops. Nevertheless, rainfed maize and wheat crops are more vulnerable to climate change. The results for the Latin American and Caribbean region, and SubSaharan Africa were mixed in terms of yields of crops grown in these regions. Enhanced CO_2 on Crop Growth "Crop species vary in their response to CO_2. Wheat, rice, and soybeans belong to a physiological class (called C3 plants) that respond readily to increased CO_2 levels. Corn, sorghum, sugarcane, and millet are C4 plants that follow a different pathway. The latter, though more efficient photosynthetically than C3 crops at present levels of CO_2, tend to be less responsive to enriched concentrations. Higher levels of atmospheric CO_2 also induce plants to close the small leaf openings known as stomata through which CO_2 is absorbed and water vapour is released... Thus, under CO_2 enrichment, crops may use less water even while they produce more carbohydrates. This dual effect will likely improve water-use efficiency, which is the ratio between crop biomass and the amount of water consumed. At the same time, associated climatic effects, such as higher temperatures, changes in rainfall and soil moisture, and increased frequencies of extreme meteorological events, could either enhance or negate potentially beneficial effects of enhanced atmospheric CO_2 on crop physiology". (Hillel, 1995). Weeds, Pests and Diseases Increased CO_2 leads to strong

vegetative growth in both crops and weeds alike as a result of which weeds become more prolific and are expected to spread to newer places. There are also studies which prove that higher levels of CO_2 lead to herbicide resistance as a result of which more and more herbicides have to be applied. This may also have serious health implications in time to come. Besides, higher temperatures are favourable for insects and pest proliferation. Longer growing seasons will enable insects and pests to complete larger number of reproductive cycles. Changed wind patterns would lead to spread of wind-borne pests and diseases to newer areas. Warmer winter temperatures may shorten the overwintering period of pest larvae resulting in higher proliferation in the next season. Thus, an increase in weeds, pests and diseases could soon be a problem calling for immediate. Crop Quality Food systems can be vulnerable to climate change. Grain quality of wheat (e.g., protein content) is highly susceptible to current variations in climate and affects the type of foods that can be produced through, for example, gluten levels and related dough strength (Porter & Semenov 2005). Other examples of the effects of climate on crop quality include pests and diseases, such as dangerous levels of mycotoxin contamination of groundnuts (Julia M Slingo, 2005). Livestock Climate change is expected to impact both crops and livestock alike. Increased temperature is bound to increase stress levels among livestock. This may result in decline in the rate of reproduction, increased incidences of diseases and also loss of appetite. Increased levels of CO_2 in the atmosphere may result in production of less nutritious feed and forage which may be required to be supplemented by additives, thus adding to the cost to the grower. 9.6.6 Prices, Production and Food Consumption The results reveal that though, even without climate change, the prices of rice, maize, soyabean and wheat are bound to rise between 2000 to 2050, however, with climate change, there will be additional price increases to the extent of a total of 32 to 37 percent for rice, 52 to 55 percent for maize, 94 to 111 percent for wheat, and 11 to 14 percent for soybeans. Though the study does not show any direct effect on livestock due to climate change, the effects of higher feed prices caused by climate change pass through to livestock, resulting in higher meat prices. For example, the prices of beef will be 33 percent higher due to no climate change by 2050 and 60 percent higher with climate change. Importantly, the negative impacts of climate

change and variability shall be markedly observed in Sub-Saharan Africa and South Asia. The results have also shown that climate change reduces the consumption of meat slightly and of cereals substantially indicating negative welfare effects due to climate change. The results of the study showed that without climate change, the calorie availability increases throughout the world by 2050 whereas with climate change, the calorie availability showed marked reduction relative to 2000 levels. Further, climate change and variability encompass increased frequency of extreme weather events like heat waves, droughts, etc. Heat waves, specially occurring during some crucial stages of plant life cycle like pollination or pod set can limit yields. Heat waves can also cause wilting due to excessive transpiration, unless they are provided with irrigation. Droughts result in long term lack of water availability in plants resulting in famines. Strong winds can damage the leaves and heavy rains can cause flooding, both of which can be detrimental to the crops. If the temperature rise occurs in cooler areas of the world, those places will become more habitable and we may witness crops moving their ranges. In areas where crops are being grown in their warmest productive temperature ranges already, heat stress or increased disease could reduce yields. When temperatures exceed the optimal for biological processes, crops often respond negatively with a steep drop in net growth and yield. If night time temperature minima rise more than the daytime maxima--as is expected from greenhouse warming projections--heat stress during the day may be less severe than otherwise, but increased night time respiration may also reduce potential yields. Another important effect of high temperature is accelerated physiological development, resulting in hastened maturation and reduced yield.(Hillel, 1995). Since agriculture is dependent on rainfall, any change in its pattern or total precipitation will significantly affect agriculture. Moisture stress, especially during important stages of plant growth like pollination, flowering and grain filling is harmful. Increase in temperature may lead to higher rates of transpiration causing moisture stress in plants and would call for increased need for irrigation. In coming years, the demand for water for irrigation may increase due to warmer climates and agriculture may have to compete with other industries for water. Less rainfall also results in falling water tables which would also increase the energy needed to pump underground water.

Scientists and plant breeders are working towards developing new drought resistant varieties of various crops.

SPECIES EMERGENCE AND EXTINCTION

Melting of the Polar ice: Increasing atmospheric warming is causing polar ice to melt and Sea-ice in the Arctic has shown significant changes in coverage and thickness over the last 30 years. Studies show that, between 1980 and 2008, the extent of sea ice has declined by an average of 11%, with evidence of a recent acceleration and between 1980 and 2008 (28 years), the thickness of sea ice reduced by 50% to 1.75 m.

Rising Sea Levels: Sea level monitoring programmes and other data indicate increased sea levels currently compared to the past 2000 years. Sea expands when its water temperature increases. Likewise, melting of glaciers and polar ice leads to rising in sea level. Human activities like draining wetlands, groundwater withdrawal, dam construction, and land use change also contribute to sea level rise. Sea level rise is a serious concern as 41% of the world's population lives within 100km of the coast. The current rate of increase in sea levels (3.1mm per year), is higher than that the values predicted by the IPCC for 2100. However, these rates are not similar globally and have special variability. Changes to the Ocean's Major Current Systems Changes in ocean temperatures and wind patterns will affect and alter oceanic currents. As the ocean currents play a significant role in maintaining Earth's climate, changes in the ocean's major current systems will have major repercussions for the global climate. Oceanographers have observed changes in the North Atlantic Ocean currents on account of increase in sea surface temperature and increase in melting of ice. The Atlantic plays a key role in managing global ocean currents. The sinking of large amounts of cooler water in this ocean creates currents in the Southern and Pacific oceans. Hence a slowing down of the currents in this region has global impacts. The entire Northern Hemisphere cools, Indian and Asian monsoon areas dry up, North Atlantic storms get amplified and less ocean mixing results in less plankton and other life in the sea. Also, it would lead to heating up of the southern hemisphere. The IPCC concluded that the circulation may reduce

up to 54% by this century if temperature increases by 4 degrees C and GHG emissions keep increasing.

MIGRATION PATTERN: The distributions of many marine species including those we rely on for food are shifting because of their dependence on specific water temperatures and nutrient availability. Many marine species are moving toward the poles disrupting fisheries around the world. A recent study noted that more than 800 species of commercially important fish, including halibut, herring, tuna, and cod have migrated north. Many marine species such as whales and salmon time their migratory and reproductive cycles around prey. Whales migrate to the Arctic to prey on krill in the summer and salmon migrate to the oceans for seasonal nutrients. When these patterns are altered due to a changing climate, it results in a change of predator-prey relationships and increases mass strandings', starvation, and poor reproductive success. For Atmosphere and Climate example, warmer sea surface temperatures along the US Northeast continental shelf are forcing a specific zooplankton species to shift to cooler waters. Atlantic Cod that prey on them in the Gulf of Maine and Georges Bank are found to have lower reproductive success. A recent study predicts that climate change will force hundreds of ocean fish northward. Northward shifts of warm water species by more than 10° latitude coinciding with a decrease in the number of cold-water species are related both to the rise in temperature in the Northern Hemisphere and to the North Atlantic Oscillation. A large number of biological events concerning maximal phytoplankton abundance as well as reproduction and migration of invertebrates, fish, and seabirds, all take place earlier in the year. Hence, in the past fifty years, the spring events have been shifting earlier for many species by an average of 4.4 ± 0.7 days per decade and the summer events by 4.4 ± 1.1 days per decade. Observations show that for all taxonomic groups, with great heterogeneity, the rate of displacement towards the poles reaches 72.0±13.5 kilometres per decade. Changes in the distribution of benthic, pelagic and demersal species can extend up to a thousand kilometres. These poleward migrations have led to an increase in the number of warm-water species in areas like the Bering Sea, the Barents Sea or the North Sea. The observed modifications in the distribution of benthic fish and shellfish with latitude and depth can be mainly explained by changes in the temperature of the

sea. The migration rates recorded in the marine environment appear to be faster than observed in the terrestrial environment.

DIRECT EFFECTS ON HUMAN HEALTH: According to a report of the World Bank in 2010 the baseline health of a country is related to the amount of impact that could be caused due to climate change and also the costs for its adaptation. Therefore the likely risks and impacts of climate change vary between countries. A small change in the global climate will affect the normal functioning of the earth's ecosystems. Some countries may experience extreme cold temperatures and people living in such areas would want warmer climates; for example the USA. Likewise certain areas may receive very hot temperatures and people would want cooler temperatures. These changes in climate can lead to beneficial and/or Atmosphere and Climate adverse effects. The changes that may be witnessed initially may be some changes in the seasonality of some infectious diseases. This includes vectorborne infections such as mosquito-borne diseases: dengue, chikungunya and so on that strike during the warmer periods. Some plant and animal varieties may die or even go extinct due to changes in climate variability, whereas some species are able to adapt themselves to the changed conditions. Some other significant impacts of climate change include changing food productions, agrarian distress and socio-economic issues. The table 12.1 given below gives you an idea of some environmental changes, the diseases caused therein and the different pathways responsible for bringing about infectious diseases in human beings.

CLIMATE CHANGE IMPACTS ON HUMAN SETTLEMENTS, MIGRATION AND LIVELIHOOD: Climate Change Impacts on Human Settlements and Migration From time immemorial humans have travelled and settled along coastlines and other places for their livelihood and better opportunities. Some people are displaced due to conflicts, dam construction related issues and also due to catastrophes such the 2004 tsunami where millions were affected and displaced. Drought and extreme climatic events also force people to search for better economic conditions and employment either temporarily or permanently. Another example is the 2008 Kosi floods that displaced many in Nepal and India. These events are sudden and sometimes unforeseen events. Sudden-onset hazards have

forced several million to migrate to other areas. The hazards cause physical loss of land and natural resources and people are unable to cope or adapt with the changes. On the other hand, drought is a slow creeping hazard. Slow-onset hazards still give people time to adapt themselves to the situation by regenerating the soil fertility and using appropriate seeds for cultivation etc. There are many factors that influence human migration. They include social, environmental, cultural, economic and political. The Paris Agreement gives references to migration and displacement. In the preamble, it refers to the vulnerability of migrants, and calls on states to 'respect, promote and consider their respective obligations on human rights' when taking action to address climate change (UNFCCC, 2015: 1). It also addresses the need for a task force to 'develop recommendations for integrated approaches to avert, minimize and address displacement related to the adverse impacts of climate change' (UNFCCC, 2015). The Hyogo Framework for Action also recognized displacement as a potential driver of vulnerability (UNISDR, 2005). The Sendai Framework focuses on displacement in response to extreme events (UNISDR, 2015). Therefore, climate change brings about migration both within and crossborders. Climate Change Impacts on Livelihoods. Livelihoods can be defined as the different types of assets, abilities and activities that enable a person or household to survive (FAO, 2003). These assets include physical assets such as infrastructure and domestic assets; financial assets such as cash, jewellery, savings, mutual funds and pensions; natural assets such as natural resources, land for agriculture; social assets, which are based on the cohesiveness of people and societies; and human assets such as education and skills for survival. All these assets change with time (with cycle of events, we may lose or earn the assets) and are always different for various households and communities. In general, we should have a mix of assets so that we can tide over difficult situations. Our ancestors always believed in having mixed assets. In society we have different groups, various communities and not all can adapt to the climate change driven impacts. The marginal groups are those people who have few or lesser resources and power and they are not able to adapt themselves to the changes. In fact, they can be negatively impacted. It is usually people's few productive assets that are at greatest risk from the impacts of climate change. In principle, all the physical assets can be damaged, financial

losses can occur, natural assets can be degraded or even destroyed and social assets can be undermined. Climate variability can result in certain food products becoming scarce at certain times of the year. Such seasonal variations in food supply, along with vulnerabilities to flooding etc. can impact livelihoods. Although these impacts might appear indirect, they are important because many marginal livelihood groups are close to the poverty line. Food is a key element of their existence. The main source of livelihood for the marginal groups is agriculture, livestock rearing and fishing. In most instances the challenges encountered by the rural livelihoods drive urban migration. When the numbers of the poor and vulnerable groups in urban slums increase, the availability of employment opportunities which are non-agriculture/non-farm based and the access of urban dwellers to obtain sufficient food products from the market will become increasingly important drivers of food security. A study by the International Labour Organization study (ILO, 2005) reports that there will be significant variations among the low income and middle-income countries in regarding the impacts of climate variability on livelihoods dependent on agriculture. The livelihood groups that are of concern in the context of climate changes include the low-income group affected by drought and flood; those who have poor food distribution and emergency response mechanisms. For example, fishermen living along the coastlines may experience sea-surges, storms, tsunamis and their fishing infrastructures may be damaged. They can lose their homes constructed nearby that are washed away by the storms. What happens to their livelihoods then? In the same way farmers may experience flash floods, wherein their land can be completely submerged and their crops may be destroyed. So, such changing temperature and rainfall conditions can devastate their livelihoods immediately. Therefore, climate change has 225 Atmosphere and Climate serious consequences and affects the lives of a million people around the world. Adaptation measures are necessary to address these concerns. They include preparing heat wave early warning systems, urban planning to reduce the urban heat island effect, better land-use planning, community relocation, reducing the vulnerability of essential services such as water, energy and food, and measures to assist vulnerable sectors and households. In addition, early warning systems and flood and cyclone shelters are also important health related adaptation strategies.

MITIGATION

AGRICULTURE AS A SINK FOR GREENHOUSE GASES: Agriculture sector can also act as a sink to GHG. Firstly, agricultural sector can reduce its own emission. Plants use CO2 for photosynthesis. Hence, they have the ability to offset emissions from other sectors by reducing CO2. The biomass generated in agricultural sector can be used to produce biofuels which can be a substitute to fossil fuels which are currently used for energy. Improved management practices in agriculture can help in storage of carbon in plants and soils. Every tonne of carbon added to, and stored in, plants or soils removes 3.6 tonnes of CO_2 from the atmosphere (Paustian et. al, 2006). Agriculture can increase soil carbon by the following: 1) Cropland Management: Several management practices can increase cropland soil carbon. Carbon inputs to soil can be increased by increasing crop productivity, growing crops that produce large amounts of residues, doing away with the practice of fallow periods between crops, efficient use of fertilizers, manures and irrigation and use of zero tillage or low tillage practices. 2) Management of Grazing Land: Soil carbon of grazing lands can be increased by improved management practices. These management practices include use of proper fertilization, irrigation, cultivation of legumes, improved grazing and use of improved grass species. 3) Changes in land use can also help to increase carbon in soil. Conversion of crop lands to forests or grassland scan increase soil carbon. Highly degraded areas like reclaimed mines, saline soils and eroded lands have high potential of carbon sequestration if a productive plant cover with high rates of carbon inputs from residues can be achieved.

The **Ocean** acts as a carbon sink by absorbing large quantities of CO_2. The CO2 absorption capacity of the ocean is ten times than that of fresh water, as CO_2 is immediately reactive in sea water. This phenomenon causes changes in the chemical properties of the ocean.

ADAPTATION TO CLIMATE CHANGE: UNCCD policy brief (UNCCD, 2009) talks about adaptation approaches to climate change, especially drought. These strategies can be extended to other climate change scenarios as also. Early Warning Systems: If the possibility of a potential disaster is known in advance, communities can be motivated to establish safeguards particularly at household levels. Strengthening

Coping mechanisms: New adaptive mechanisms need to be designed based on indigenous knowledge and traditional practices. This would strengthen the capacity of local people to address the issue of climate change within their own communities and social structure. Mitigation activities to support adaptation: Actions promoting Sustainable Land Management improve the natural resource base of a region by restoring soil fertility, improving water availability, etc. Joint Forest Management: Conserving and establishing forests by the communities can help in checking moisture and soil loss and improving soil quality. Diversification of Livelihoods: Studies assessing the diverse systems of a region supporting the local livelihoods and their resilience to climate change will help in determining viable new options that provide innovative solutions. Local Governance: Participation of local communities in policy formulations and project development is very essential. The ability of these communities to develop the rationale for new technologies is crucial to their ability to be flexible when there is great uncertainty. Climate Insurance: Financial instruments on which the communities can bank upon at times of unanticipated risks are a priority.

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Chapter - 7

A Review of Climate Change and Healthcare Challenges in New India

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Abstract- Human population is subjected to biggest health threat because of Climate change. Climate change affects the clean air, safe drinking water, sufficient food, and secure shelter, which are social and environmental determinants of health. Air, water, and food are the basic necessities of life, but they are also the carrier of bacterial, viral, and parasitic diseases. The negative effects of climate change like floods, drought, excessive heat, etc, are disturbing the balance of nature, giving these pathogens a breeding ground. While no one is safe from these risks, the people whose health is being harmed first and worst by the climate crisis are the people who contribute least to its causes, and who are least able to protect themselves and their families against it, that are people in low-income and disadvantaged communities. In India weak health infrastructure will be the least able to respond and cope up with these challenges.

Keywords: Climate change, healthcare, India, public health

INTRODUCTION

Climate change is a threat to public health security – from extreme weather-related disasters to wider spread of vector-borne diseases as malaria and dengue, which is unevenly distributed around the world.

According to the “Third Assessment Report” (IPCC, 2001) human health vulnerability to climate change is a function of exposure, sensitivity, and adaptive capacity. Since, developing country are densely populated so are particularly vulnerable.

India is a large developing country with more than one billion population. There is 7500 km long Great Himalayas in the north, and 6100 Km long densely populated coast line in the south. About 70% of its population reside in rural and semi-urban areas which directly interacts with the natural resources such as water, biodiversity, mangroves, coastal zones, grasslands and completely hang on on climate-sensitive sectors like- agriculture, forests, and fisheries. Owing to pollution, land use changes, and climatic factors, India is experiencing a hotter climate year on year, resulting in higher temperatures and untimely rainfall. Heat waves, draughts, land, and coastal floods produces a devastating impact on agriculture-based economy. These factors promote the breeding of mosquitoes and the increased transmission of vector borne diseases. (Majra and Gur, 2009)

Although it is unequivocal that climate change affects human health, it remains challenging to accurately estimate the scale and impact of many climate-sensitive health risks. However, scientific advances progressively allow us to attribute an increase in morbidity and mortality to anthropogenic global warming, and more accurately determine the risks and scale of these health threats. Recent studies also point out India's poor performance in addressing climate-related concerns. In the Environment Performance Index 2022, India ranked at the bottom of the list (Bavadam, 2022). This raises concerns about the future impact of climate change on the health of people across the country.

GLOBAL CLIMATE CHANGE OUTLINES AND INDIAN SCENERIO

Although Climate change is a natural phenomenon of decades occurring on longer time scales yet anthropogenic activities have fasten the process multi-fold. The major cause is increase in the atmospheric concentration of energy trapping greenhouse gases that primarily includes

CO_2, CH_4, CFC and Oxides of nitrogen and sulphur. Major sources of these greenhouse gases are fossil fuel combustion, forest burning, irrigated agriculture, animal husbandry, oil extraction, and compressor-based cooling devices like refrigerator and air conditioner etc. According to the "Fourth Assessment Report" these gases have increased the global average surface temperature by approximately 0.65°C over the last 50 years, thus a significant rise in sea level and increased frequency of intense cyclones. Climatologists forecast that if these situations continue over some more decades, the global mean surface temperature will rise by 1.1–6.4° C and heat waves, floods, draughts, heavy precipitation, and other extreme events will become more frequent and intense.

The latest high-resolution climate change scenarios and projections for India, based on the Regional Climate Modeling system, known as PRECIS, developed by the Hadley Center and applied for India using IPCC scenarios A2 and B2 (Kumar, 2005) show an annual mean surface temperature rise by the end of the century, ranging from 3 to 5°C under the A2 scenario and 2.5 to 4°C under the B2 scenario, with warming more pronounced in the northern parts of India. A 20% rise in all India summer monsoon rainfall and further rise in rainfall is projected over all states except Punjab, Rajasthan, and Tamil Nadu, which show a slight decrease. Extremes in maximum and minimum temperatures are also expected to increase and similarly extreme precipitation also shows substantial increases, particularly over the west coast of India and west central India. Rapid mountain glacier retreat has been documented in the Himalayas, meltwater from the Himalayan glaciers contributing a sizeable portion of river flows to the Ganges, Brahmaputra, Indus, and other river systems. (Smith. 2001)

EFFECT OF CLIMATE CHANGE ON HUMAN HEALTH

Sustained public health on biosphere requires life supporting services of planet that solely depend on global climate and India is not the exception to this fact. Climate change can affect human health directly as thermal stress, death/injury in floods and storms or indirectly through changes in the ranges of disease vectors like flies and mosquitoes, water-

borne pathogens, water quality, air quality, and food availability and quality (McMichael AJ, et al, 2003). Public health, to a large extent, depends on safe drinking water, sufficient food, secure shelter, and good social conditions. A changing climate is likely to affect all these conditions. Climatic stability confers physical safety and comfort to the populations. Changing temperatures and precipitation patterns linked to climate change will further affect health by changing the ecology of various vector-borne diseases, such as malaria, dengue, chikungunya, Japanese encephalitis, kala-azar, and filariasis (Bhattacharya et al. 2006; Dhiman et al. 2008).

Climate change is already impacting health in a myriad of ways, including death and illness from increasingly frequent extreme weather events, such as heatwaves, storms and floods, the disruption of food systems, increases in zoonoses and food-, water- & vector-borne diseases, as well as mental health issues. Furthermore, climate change is undermining many of the social determinants for good health, such as livelihoods, equality and access to health care and social support structures. These climate-sensitive health risks are disproportionately felt by the most vulnerable and disadvantaged, including women, children, ethnic minorities, poor communities, migrants or displaced persons, older populations, and those with underlying health conditions. Climate change creates a conducive environment for the creation and transmission of several communicable diseases like malaria, dengue, diarrhoea, etc. For example, when flood water gets contaminated with human or animal waste, water-borne diseases like diarrhoea and cholera start spreading faster.

HEALTHCARE CHALLENGES IN INDIA

Climate change already contributes to the global burden of disease and this contribution is expected to grow in the future. Approximately 600,000 deaths occurred worldwide as a result of weather-related natural disasters in the 1990s, some 95% of which took place in developing countries (WHO, 2002). As per National Communications Report of India to the United Nations Framework Convention on Climate Change, climate

change is likely to impact all the natural ecosystems as well as socioeconomic systems (UNFCCC, 2004). Some of the Public Health challenges of various climate change patterns in India are summarized as below-

1. EXTREME TEMPRETURES

Health effect of temperature extremes are obvious and sometimes fatal. India experiences a wide range of temperature extremes having cold waves in hilly mountains to heat waves in plains and coastal areas. It grabs more than one thousand life every year (WHO, 2008). In the recent decades, highest temperature at some places in India touched as high as 47^{o}C which is 10^{o}C above the normal.

2. EXTREME WEATHER EVENTS

Extreme weather events such as severe storms, floods, and drought have claimed thousands of lives during the last few years and have adversely affected the lives of millions and cost significantly in terms of economic losses and damage to property. India and the subcontinent saw five of the 20 major natural calamities recorded worldwide in terms of victims, including 1999 cyclone of Orissa, floods of Chennai, 2004 Tsunami, 2005 rains and floods of Maharashtra, and 2005 cyclones of Andhra Pradesh etc. These climate extremes, apart from health, also damage the public health infrastructure. India, like other developing countries, is poorly equipped to deal with weather extremes. Hence, the number of people killed, injured, or made homeless by natural disasters has been increasing rapidly. (WHO, 2005)

3. VARIABLE PRACIPITATION PATTERN

Precipitation pattern of country had been variable since last few decades. Places like cherrapunjee in Meghalaya which is known to be the wettest places are facing rare rain crisis while the dry plateau regions like Maharashtra are flooded with heavy rain. On the other hand, dry seasons are wet heavily while rainy months are suffering with low monsoon. Water scarcity already affects four of every 10 people. A lack of water and poor water quality can compromise hygiene and health. This increases the risk of diarrhoea, which kills approximately 1.8 million people every year, as well as trachoma (an eye infection that can lead to blindness) and other

illnesses. Many diarrheal diseases vary seasonally, suggesting sensitivity to climate. In India, like in other tropics, diarrheal diseases typically peak during the rainy season. Both floods and droughts increase the risk of diarrheal diseases. Major causes of diarrhoea linked to heavy rainfall and contaminated water supplies are cholera, cryptosporidium, *E. coli* infection, giardia, shigella, typhoid, and viruses such as hepatitis A. (WHO, 2005; Wilson, 2001)

4. RISING SEA LEVELS

India has a very long densely populated coastline which is highly vulnerable to coastal floods. Potential effects on health due to sea level rise include-Death and injury, Reduced availability of fresh water due to saltwater intrusion, Contamination of water supply through pollutants from submerged waste dumps, change in the distribution of disease-spreading insects, health effect on the nutrition due to a loss in agriculture land and changes in fish catch, health impacts associated with population displacement. Any increase in frequency and severity of these extreme climate events or change in coastline as projected is likely to have serious effects and can cause population displacement. These displaced people are likely to face diverse health consequences – traumatic, infectious, nutritional, psychological, and other – that occur in demoralized and displaced populations in the wake of climate-induced economic dislocation, environmental decline, and conflict situations. (WHO, 2005).

5. RETRACTING GLACIERS

Most of the states in the North, including Punjab, Haryana, Rajasthan, Uttar Pradesh, Madhya Pradesh, and the north east are dependent on river water with origin in the Himalayas. Rising temperatures may cause the snow to melt earlier and faster in the spring, shifting the timing and distribution of run-off. Projections are for a regression of the maximum spring stream-flow period in the annual cycle of about 30 days and an increase in glacier melt run-off by 33–38%. These changes could affect the availability of freshwater for natural systems and human use. Excessive melt water could cause flash floods. Melting

glaciers in the Himalayas may lead to glacier lake outburst floods, as occurred in Himachal Pradesh. (Lendrum etal., 2007).

6. FOOD INSECURITY

Increasing temperatures and more variable rainfalls and loss of agricultural land due to flash floods are expected to reduce crop yields ultimately leading to food insecurity in country where malnutrition is already an important public health problem. Malnutrition causes millions of deaths each year, from both a lack of sufficient nutrients to sustain life and a resulting vulnerability to infectious diseases such as malaria, diarrhoea, and respiratory illnesses. Simulations using dynamic crop models indicate a decrease in the yield of crops as temperature increases in different parts of India. Anaemia is also a bigger outcome of Malnutrition which may lead to maternal mortality, weakness, diminished physical and mental capacity, increased morbidity from infectious diseases, perinatal mortality, premature delivery, low birth weight, impaired cognitive performance, motor development, and scholastic achievement. (NFHS, 2007; WHO, 2008).

7. VECTOR BORNE AND OTHER DISEASES

Climatic variations are prospective to alter the frequency and length of transmission seasons and geographic range of important vector-borne diseases like malaria and dengue. Excessive monsoon rainfall and high humidity have been identified as a major cause of enhanced mosquito breeding and survival. Recent analyses have shown that the malaria epidemic risk increases around five-fold in the year after an El Niño event (Bouma *etal.,* 1996). In India, the transmission windows for malaria are predicted to increase with climate change (). Dengue is another important arboviral disease of humans, occurring in tropical and subtropical regions, particularly in urban settings. Since 1960, more than 50 outbreaks have been reported to or investigated by the National Institute of Communicable Diseases in India. The 1996 epidemic in New Delhi was the worst of its kind, which affected 16,517 persons and killed 545 (Lal and Adarsh, 2007). Warmer temperatures enhance vector breeding and reduce the pathogen's maturation period within the vector organism.

Rodents, which proliferate in temperate regions following mild wet winters, act as reservoirs for various diseases. Certain rodent-borne diseases are associated with flooding, including leptospirosis, tularaemia, and viral haemorrhagic diseases. Other diseases associated with rodents and ticks, and which show associations with climatic variability, include Lyme disease, tick-borne encephalitis, and Hantavirus pulmonary syndrome (Wilson, 2001).

8. OTHER EFFECTS

Increasing global temperatures affect levels and seasonal patterns of both man-made and natural air-borne particles, such as plant pollen, which can trigger asthma. About 6% of children suffer from respiratory tract infection and 2% of adults suffer from asthma (NFHS, 2007). Asthma deaths are expected to increase by almost 20% in the next 10 years if urgent actions to curb climate change and prepare for its consequences are not taken (WHO,2008).

Stratospheric ozone depletion is essentially a different process from climate change. However, greenhouse warming is affected by many of the chemical and physical processes involved in the depletion of stratospheric ozone. Exposure to ultra violet radiation has been implicated as a cause of skin cancer (melanoma and other types) in fair-skinned human populations living at mid to high latitudes and to induce immunosuppression that could influence patterns of infectious disease. (Madronich and de Gruijl, 1993; Ponsonby etal., 2002).

STRATEGIES TO COUNTERACT CLIMATIC HEALTHCARE CHALLANGES

There are two types of strategies to respond for protecting health from effects of climate change- 'Mitigation' and 'Adaptation.' Adaptation can reduce sensitivity to climate change while mitigation can reduce the exposure to climate change, including its rate and extent (Yohe and Ebi, 2005).

The mitigation of greenhouse gases provides a mechanism for slowing, and perhaps eventually halting, their build-up in the atmosphere.

Emission of greenhouse gases can be reduced by more efficient use of energy, reducing dependence on carbon energy, and switching to low-carbon energy like solar, hydro, or wind energy, etc. Steps to reduce greenhouse gases emissions lessen the health impacts of climate change. For example, promoting the safe use of public transportation and active movement, such as biking or walking as alternatives to using private vehicles, could reduce carbon dioxide emissions and improve public health. They can not only cut traffic injuries but also air pollution and associated respiratory and cardiovascular diseases. Increased levels of physical activity can lower the overall mortality rates. A slowing of the rate of warming by mitigation of greenhouse gases could yield important benefits in the form of reduced impacts to human health and other systems. However, the inertia in the climate system means that there will be a significant temporal lag between emission reduction and slowing in the rate of warming.

Even if greenhouse gas emissions are reduced in the near future, Earth's climate will continue to change. Hence, adaptation strategies must be considered to reduce disease burdens, injuries, disabilities, and deaths. Extreme weather events can have vastly different impacts because of differences in the target population's coping capacity. The rebuilding and maintaining of public health infrastructure is often viewed as the “most important, cost-effective, and urgently needed” adaptation strategy (McMicheal etal., 2003). This includes public health training, more effective surveillance and emergency response systems, and sustainable prevention and control programs. Education, awareness-raising, and the creation of legal frameworks, institutions, and an environment that enables people to take well-informed, long-term, sustainable decisions are also of paramount importance. Adaptive capacity is also a function of current population health status and pre-existing disease burdens. The main determinants of a community's adaptive capacity are economic wealth, technology, information and skills, infrastructure, institutions, and equity. In India, the impacts of major vector-borne diseases and disasters can limit or even reverse improvements in social development (Bouma etal., 1997).

CONCLUSION

India needs a more resilient healthcare infrastructure to counter its impact. It is the high time for Indian health care system to become more responsive to climate change-related illnesses. Public awareness, vaccination, rational distribution of healthcare products and better sanitary conditions should be our priority to achieve protection from it.

It will be critical for India to invest in improvements in information infrastructure that are innovative and that promote interdisciplinary collaborations while embarking on adaptation strategies. This will require unprecedented levels of collaboration across diverse institutions in India and abroad. The data can be used in research on the likely impacts of climate change on health that reflect India's diverse climates and populations. Local human and technical capacities for risk communication and promoting adaptive behaviour must also be enhanced.

Any further increase, as projected in weather-related disasters and related health effects, may cripple the already inadequate public health infrastructure in the country. Hence, there is an urgent need to respond to the situation. Response options to protect health from effects of climate change include mitigation as well as adaptation. Both can complement each other and together can significantly reduce the risks of climate change.

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Chapter - 8

Declining Biodiversity

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Abstract- The risk of gradual decline in the biodiversity is increasing with the high rate due to the various hazardous factors of threatening pace. Somehow, these factors are physiochemical, natural, man-made obstructions, hinderance of calamities and most importantly climate change. Though, environmental problems are intimating 'stress' caused due climatic factors and adverse change in climatic conditions due to abundancy of such stress elements are causing the 'curse' and making the 'sin' to the biodiversity. As environment is diminishing day by day, relationship between biotic and abiotic system is losing equilibrium and this little shift in equilibrium is creating the fast and narrow end of extinction of biodiversity. The loss in biodiversity is creating a question for the economic and sustainable growth of our country that what is there which can alter the activity of Ecosystem to make the things normalize and stable. Biodiversity impacts environment with the high rate of beneficiary and ecosystem functions to provide goods and services needed to the prosper.

Keywords – Calamities, diminishing environment, hazardous factors, loosing equilibrium.

Introduction

As we know that biodiversity is the way to live a vibrant life for that we need to understand the care and the things for maintaining wellness of it. It is unevenly and widely distributed on the earth in discontinuous fashion. Near the tropic line it is abundantly found with huge and diversified manner. Biodiversity is the variability of life on the earth as species to genetics diversification is there. The productivity depends on the distribution, tropic region produces the highest amount as compared to the less abundant area. Biodiversity works with ecosystems maintaining the flow of energy with different tropic levels so, that the peace in the equilibrium remain intact. But there is some defects from obstructions are occurring day by day, which may be the red sign of extinction of biodiversity. These defects are the factors that are creating enormous harm to the relationship of biotic and abiotic system and causing dismantling the ecosystems. Human actions are the only responsible source of creating this misbehave towards the environment. Compelling evidence now shows that the reverse is also true: biodiversity in the broad sense affects the properties of ecosystems and, therefore, the benefits that humans obtain from them. The effective utilization of resources in the modern scenario impacts this huge loss or diminishing biodiversity for the economic betterment or human development without thinking and understanding the boon or bane of the thing.

What is this biodiversity loss and how it is declining ?

After reaching the scientific approach and the enormous literature review of the current scenario makes the status Which spell out the declination or loosing biodiversity efficiently. To ameliorate and slump the defects or the factors responsible for this unwanted need of loss, some goals are also developing. Diversity of flora as well as fauna are on the bright light of extinction due to the habitat loss, overuse of resource, climate change due to global warming, deforestation and promptly man-made impediments like industrialisation are creating hurdles for the free movement of specie. This is the embarrassment of nature or an obstacle in the flow of energies among different tropic levels are stumbling blocked.

Actually we all are dependent on Biodiversity in many ways: -

As per the UN reports about the biodiversity i.e., United National Biodiversity Conference (COP 15), it is aimed for the development of the Rules and Goals favouring the betterment and protection of nature by 2030. Life is only possible on the earth due to the richness of nature with its numberless resource qualities which are utilitarian for humans. Economic wealth of our country also depends on it as a materialistic thing for establishing a business or model. It is already proven that biodiversity is a huge hub of life, as it envelopes the large species of flora and fauna both together with microorganisms like fungi and bacteria (makes high economic rate). Nature circumscribes with biotic and abiotic factors collectively, abiotic like – climate, soil, water, air and so on. Some-how this border of life is in crisis, that is why the goals to cure and compensate the losses should be needed urgently. The resources we need for survival, are also getting from the nature supported by biodiversity is efficiently and efficaciously dropping which may be a depressive factor for the economic building of our country. Security, food and nutrition, energy, development of medicine and pharmaceutics, everything is supported by biodiversity. Even to fight a imperilment of disease or anything can be a possibility due to biodiversity. Indirectly or may be directly our life style is surely depending on biodiversity, from clothing to livelihood.

Evolution of biodiversity, which is now tending to its extermination: -

If we push the brain towards the evolutionary phase of biodiversity, it seems to be a million years ago. The complexity of the fact of evolution is in the race of scientific research these days. It is already proven that increased pace or diversification occurred concurrently in the time of 100 million years ago and more diversified forms of live comes to our knowledge today with a rapid surge. But, modern trends of this life are making it critically stayed. Disappearance of biodiversity is just next to it, as scientists are preconditioning for its death.

Major Issues at the helm of declining biodiversity: -

If we talk about inclusively, there are enormous issues through which the biodiversity is in the red zone. These are followed below –

1. Change in human behaviour - Human impact is one of the most prominent factors responsible for the destruction in nature. Like – land use for developing industries led to the habitat loss of the living species of that particular area. Overexploitation on the extreme rate of natural resources for our betterment, overhunting, overharvesting to get the proper livelihood is creating the foe relations with our environment. Human habits are seeming to be the highly influenced for disturbed biodiversity.

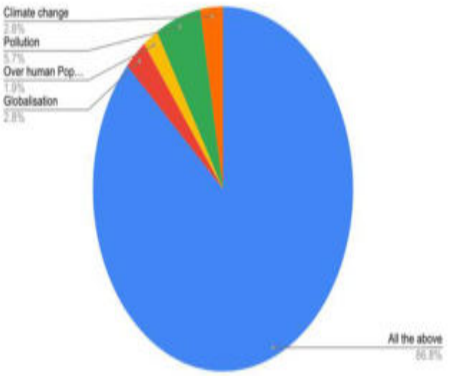
2. Deforestation, global warming and impacts of urbanisation - These are the anthropogenic actions usually creating a negative way of development. IPBES (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services) accounts anthropogenic actions as the drivers of biodiversity loss. Biological invasions, sea-use change is some of the drivers other than deforestation and urbanisation. Similarly, these hinderances are also making things unvalued and unfavoured for the biodiversity.

3. Pollution – It is a chief or a foremost reason occurred as an obstacle for the proper maintenance of ecosystem driving the equilibrium needed for the stability in biodiversity. Types of pollutants exert influence on environment in different ways, through eradicating the fertility of soil, befouling water bodies with deleterious contaminants, creating invasive injurious agents in the air causing the weep of diseases.

4. Climate change - It is one of the main drivers of biodiversity loss, mostly due to human activities again, somehow, temperature is increasing due to the anthropogenic actions against of biodiversity. The fluctuation in the climate patterns accounts the death of many living species. This acquaintance of change in climate rapidly is almost explaining the loss factor of biodiversity. Climate change affects the natural living species in the tropic regions as well, even the actual fact of danger lies here that the living species are now unable to migrate.

5. Invasive alien species – The researchers and policy makers already mentioned that the increment of lethal factors of greater impact are affecting the marine biodiversity. By hook or crook, invasiveness of alien

species is impacting the socioeconomic growth or even impacts negative on human health. Reduction in economic production due to loss in marine biodiversity is also coming to the extent of the end. Biodiversity is in severe condition now, terrestrial, marine or other forms of it are not well due to invasiveness of such wan species.



The most prominent cause of declining biodiversity –

The following data specified is heeding the percentage of substantial issues that how effectively these are being the part of the diminishing biodiversity. This became in acquaintance with this data, that climate change, pollution, over human population and globalisation all these are blameworthy for the loss in biodiversity. In fair means or foul, it is iterated that pollution is utmost or considerable affair of the problem.

Figure 1.1 1: % of hazardous issues responsible for biodiversity loss

Biodiversity and Economic growth of the country –

It is already proven that biodiversity cares the country's economic health. A questionnaire of more than hundred literate or professionals believes that country's economic growth is controlled by the biodiversity by utilising the resources of several kinds which is meeting the need and needed to the prosper. Increasing evidence shows that an expanding economy demean biodiversity. In this paper, biodiversity is understood as the variability among living organisms and the ecological complexes of which they are a part. This can include variation in genetic, phenotypic, phylogenetic, and functional attributes, as well as changes in abundance and distribution over time and space, within and among species and ecosystems. The connection between economic growth and biodiversity loss can be explored by have recourse to correlations between gross domestic product (GDP), resource use and the state of biodiversity. While such associations do not necessarily implicit ancestry, the arguments assembled below suggest that causal relations do exist.

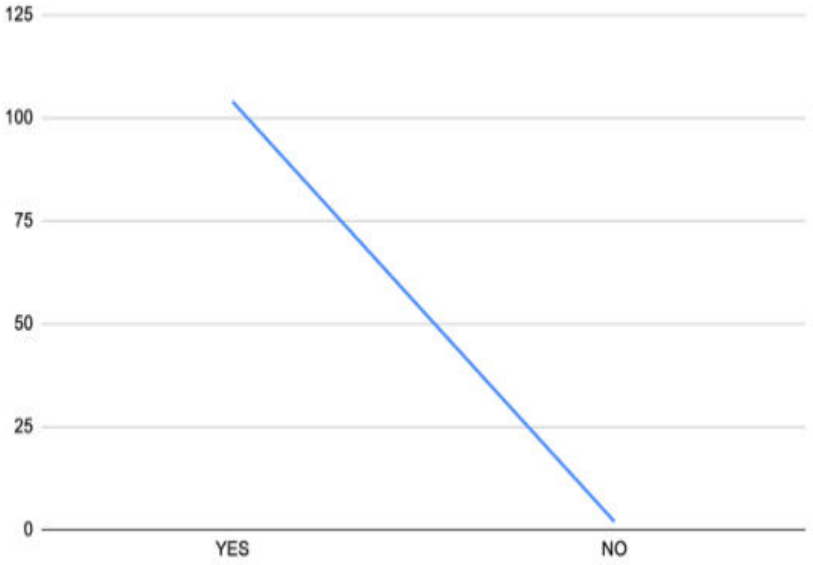
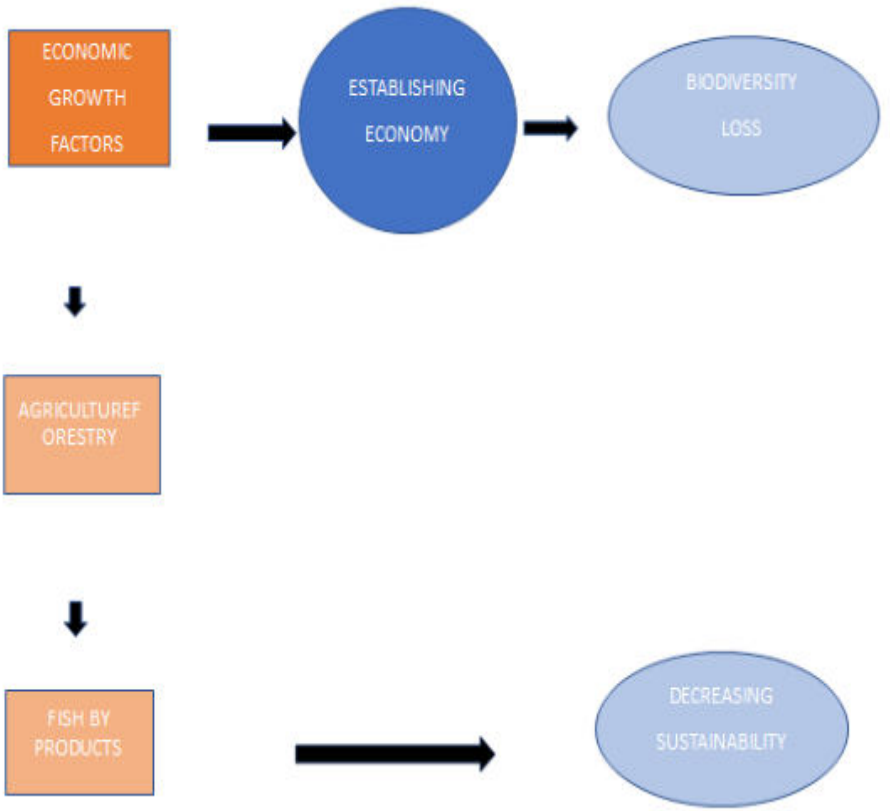


Figure.1.2: Graph showing and proving the dependency of economic growth on biodiversity (from questionnaire)

By some means, the chapter of economic growth of the country is creating a dismantle health of biodiversity and packing it to the death. The overutilization of resources is may be a beneficial aspect for building core in economy but also being in charge of dropping sustainability. As biodiversity underpins economic activity by food production, nutrition provision, disease prevention and control specifically, manufacturing of medicines and pharmaceuticals all these fundamentals rely on biodiversity and hence, is creating a economic.

Relationship between biodiversity and economy



Why biodiversity is important for the planet? –

The graph is allude to explain the importance of biodiversity in the company of planet. Most of the literates thought that it helps in maintaining the ecological balance and even all the species in an area work together to cling to life and sustain their ecosystem. Biodiversity is indispensable for the development, growth, formation of the living creatures bolster up all life possible on earth and establishing equilibrium because without the continuation of the biodiversity, the things become unhandled. As the fresh breath of life could only makes its possibility with the linger of biodiversity. But people are not valuing nature, then, it may not be a big statement, if, we consider it as a disdain of the existence of planet straightaway.

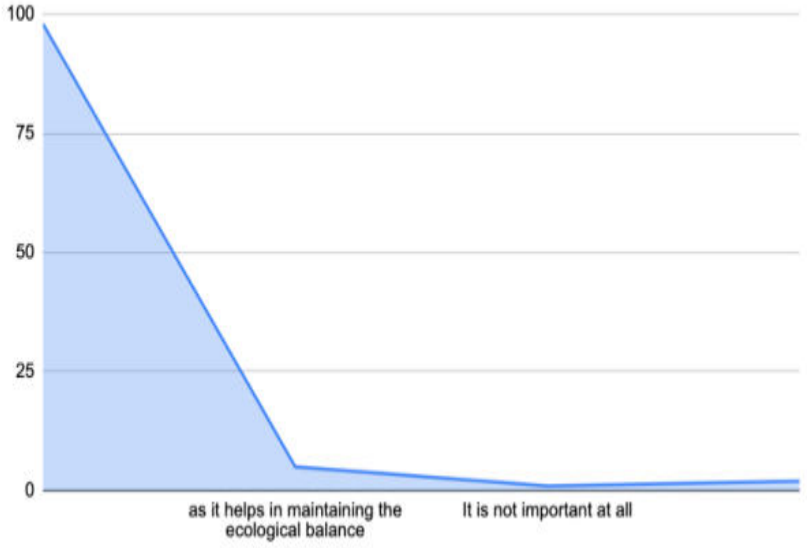


Figure.1.3: showing the importance of biodiversity to the planet (data)

What is the scale of biodiversity loss ?

The list of known recent extinctions is still a small fraction of all species on the planet but it is far above prehuman levels and the evidence suggests it is rising fast. A recent report indicated that one million species could be threatened with extinction. Since 1500, 1.6% of birds, 1.9% of mammals and 2.2% of amphibians have been recorded as extinct. Between 1990 and 2020, around 420 million hectares of forest (mainly tropical forest) has been lost and a further 10 million hectares, an area the size of Scotland and Wales combined, is being lost each year (The2). The extinction of species is on the mark and the extermination of life is making its presence efficiently.

Conclusion

The direct proportionality of population size and the pressure on ecosystem emerges the unbearable changes unless we change our pattern of consumption. The use of biodiversity in a sustainable way meant the use of resources at a rate that the nature can renew them. Only option is that to manage productivity, increase management of adaptability and traditional knowledge.

The CBD (Convention on Biological Diversity) is aiming the sectors affecting biodiversity (Agriculture, Fisheries, Tourism, Water management). They adopted the *"Addis Ababa Principle"* and Guidelines for the sustainable use of biodiversity with the fourteen principles applicable to the various fields.

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Chapter - 9

Effect of Environment on World Economy

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The issue of economic growth and the environment essentially concerns the kinds of pressures that economic growth, at the national and international level, places on the environment over time. The relationship between ecology and the economy has become increasingly significant as humans gradually understand the impact that economic decisions have on the sustainability and quality of the planet.

Economic growth will be undermined without adequate environmental safeguards, and environmental protection will fail without economic growth. The earth's natural resources place limits on economic growth. These limits vary with the extent of resource substitution, technical progress, and structural changes.

Economic growth means an increase in real output (real GDP). Therefore, with increased output and consumption we are likely to see costs imposed on the environment. The environmental impact of economic growth includes the increased consumption of non-renewable resources, higher levels of pollution, global warming and the potential loss of environmental habitats.

However, not all forms of economic growth cause damage to the environment. With rising real incomes, individuals have a greater ability to devote resources to protecting the environment and mitigate the harmful effects of pollution. Also, economic growth caused by improved technology can enable higher output with less pollution. Increased consumption of fossil fuels can lead to immediate problems such as poor air quality and soot, (London smogs of the 1950s). Some of the worst

problems of burning fossil fuels have been mitigated by Clean Air Acts – which limit the burning of coal in city centres. Showing that economic growth can be consistent with reducing a certain type of pollution.

Less visible more diffuse pollution. While smogs were a very clear and obvious danger, the effects of increased CO2 emissions are less immediately obvious and therefore there is less incentive for policymakers to tackle. Scientists state the accumulation of CO2 emissions have contributed to global warming and more volatile weather. All this suggests economic growth is increasing long-term environmental costs – not just for the present moment, but future generations.

Air/land/water pollution causes health problems and can damage the productivity of land and seas. Global warming and volatile weather. Global warming leads to rising sea levels, volatile weather patterns and could cause significant economic costs Soil erosion. Deforestation resulting from economic development damages soil and makes areas more prone to drought.

Loss of biodiversity. Economic growth leads to resource depletion and loss of biodiversity. This could harm future 'carrying capacity of ecological systems' for the economy. Though there is uncertainty about the extent of this cost as the benefit of lost genetic maps may never be known.

Long-term toxins. Economic growth creates long-term waste and toxins, which may have unknown consequences. For example, economic growth has led to increased use of plastic, which when disposedof do not degrade. So there is an ever-increasing stock of plastic in the seas and environment – which is both unsightly but also damaging to wildlife. Some resources such as water, forests, and clean air are under attack, while others such as metals, minerals, and energy are not threatened. This is because the scarcity of metals and similar resources is reflected in market prices. Here, the forces of resource substitution, technical progress, and structural change have a strong influence. But resources such as water are characterized by open access, and there are therefore no incentives to conserve. Many believe that effective policies designed to sustain the environment are most necessary because society must be made to take account of the value of natural resources and governments must create

incentives to protect the environment. Economic and political institutions have failed to provide these necessary incentives for four separate yet interrelated reasons:

1) Short time horizons;

2) Failures in property rights;

3) Concentration of economic and political power;

4) Immeasurability and institutional uncertainty.

Although economists and environmentalists disagree on the definition of sustainability, the essence of the idea is that current decisions should not impair the prospects for maintaining or improving future living standards. The economic systems of the world should be managed so that societies live off the dividends of the natural resources, always maintaining and improving the asset base.

Chapter - 10

Water Resources Management and Environmental issues for Sustainable Agricultural Production – An Analytical Study

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Introduction

"Jewels don't sustain life but Water drops do"

Water is one of the Pancha Tattva, the five prime elements of which everything is made, four others being Earth, Air, Fire, and Sky. Of these, water is the key nurturer, without which most life, including human life, cannot survive. Water, which sustains life on earth, is an invaluable natural resource. Earth is the only planet in the entire solar system which supports life, because it contains water. About 71 per cent of the surface of the earth is covered with water, but only about 3 per cent of the total water on the earth is freshwater. Water resources management is one of the key factors in development of agricultural production and related area in order to attain self-reliance in food security and also development of agro-based industries so that employment opportunity can be enhanced. Even after 73 years of independence, we have extended the irrigation facility only about 53% of the total net sown area. Government of India launched Jal Shakti Abhiyan (JSA) in 2019, a time bound campaign with a mission mode approach intended to improve water availability including ground water

conditions in the water stressed blocks of 256 districts in India. Further, **Jal Shakti Abhiyan:** Catch the Rain campaign has been launched by the Hon'ble Prime Minister of India on 22nd March, 2021 under which various activities will be carried out for rainwater conservation in all the districts of the country. Central Government has formulated the National Perspective Plan (NPP) for Water Resources Development which envisages transfer of water from water surplus basins to water deficit basins to improve availability of water.

Methodology

Data: Secondary data has been used from the published reports and datasets.

The following formulae were used:

Three Year Moving Average

$$Y_{t+1} = \frac{Yt + Y_{t+1} + Y_{t+2}}{3}$$

Where Y_t is variable (area sown, production or yield)

And t is period, say, t = 0,1,2…..

Compound growth rate

$$Y_n = Y_0(1+r)^n$$

where, Yn is projected variable value ,

Y_0 is initial variable value

r is Compound Growth Rate of variable in proportion,

n is period

$R = [(Yn/Y0)^{1/n} - 1.0]*100$

where R is Compound %age growth rate

Projection

Least Square Technique has been applied for the following linear model:

$Y = a + b X$

Where Y is Foodgrains production

a is constant

b is regression of Y on X,

X is year (X=1 for 1991-92

=2 for 1996-1997 & so on)

Findings and Discussions

Water Resources Management is one of the key factors for development of Agricultural production and related areas where water requirement is essential. The assured irrigation water supply is utmost importance for food security. Water availability per person is dependent on the population of the country and for India, per capita water availability in the country is reducing due to increase in population. Reducing per capita water: The average annual per capita water availability in the years 2001 and 2011 was assessed as 1816 cubic meters and 1545 cubic meters respectively which may further reduce to 1367 cubic meters in the years 2031.

Table -1 State-wise Net Sown Area & Net Irrigated Area (in 000 ha)				
Sl No	States/Uts	Net Sown Area (NSA)	Net Irrigated Area (NIA)	% of NIA to NSA
1	Andhra Pradesh	5884	2879	48.93
2	Arunachal Pradesh	234	56	23.93
3	Assam	2723	366	13.44
4	Bihar	5077	3059	60.25
5	Chhattisgarh	4635	1528	32.97
6	Delhi	22	22	100.00
7	Goa	127	22	17.32
8	Gujarat	10302	4233	41.09
9	Haryana	3600	3273	90.92
10	Himachal Pradesh	542	117	21.59
11	Jammu& Kashmir	720	428	59.44
12	Jharkhand	1281	231	18.03
13	Karnataka	10664	4032	37.81
14	Kerala	2026	410	20.24
15	Madhya Pradesh	15512	12517	80.69
16	Maharashtra	17406	3169	18.21
17	Manipur	446	73	16.37
18	Meghalaya	255	101	39.61
19	Mizoram	146	16	10.96
20	Nagaland	384	118	30.73
21	Odisha	4102	1137	27.72
22	Puducherry	15	13	86.67
23	Punjab	4119	4111	99.81
24	Rajasthan	18032	8821	48.92
25	Sikkim	77	15	19.48
26	Tamil Nadu	4738	2672	56.40
27	Telangana	4660	2210	47.42
28	Tripura	255	87	34.12

29	Uttar Pradesh	16538	14392	87.02
30	Uttarakhand	648	323	49.85
31	West Bengal	5250	3107	59.18
	ALL INDIA	**140420**	**73538**	**52.37**

The break-up of net sown area and net irrigated area is given in Table-1. It is seen that the All India percentage to Net Irrigated area to Net sown area is observed around 52% % during 2019-20. The highest % of NIA to NSA is observed in Punjab (99 %) followed by Haryana (91 %), Uttar Pradesh (87%) and Puducherry (86%).

Table -2 Three years moving average of Net Sown Area and Net Irrigated Area

Year	Net Sown Area M ha	Growth rate per annum	Net Irrigated Area	Growth rate per annum
1961-62	135.71		25.14	
1971-72	139.04	0.25	31.49	2.53
1981-82	140.72	0.12	39.97	2.69
1991-92	142.45	0.12	49.39	2.36
2001-02	138.00	-0.31	55.35	1.21
2011-12	140.57	0.19	63.77	1.52
2018-19	139.68	-0.09	71.54	1.74

Table- 2 Presents the three yearly moving averages of Net sown area and Net irrigated area. It is seen that Net Sown area has been increased from 135.71 M ha in 1961-62 to 142.45 M ha in 1991-92 and declined to 138.00 M ha in 2001-02 and again increased to 140.57 in 2011-12. Growth rates have been estimated for different periods. Net Irrigated area is having positive trends during all the periods. However Net sown area has positive trends except during 1991-92 to 2001-02 and 2011-12 to 2018-19.

Table -3 Three years moving average of area, production and yield of the Foodgrains

Year.	Area Sown M Hect	Growth rate per annum	Production M Tones	Growth rate per annum	Yield Kg/Hect	Growth rate per annum	Irrigated area %age
1959-60	115.39		78.61		681		18.85
1969-70	122.77	0.64	100.64	2.80	819	2.03	23.79
1979-80	126.96	0.34	123.73	2.29	974	1.89	29.6
1989-90	127.43	0.04	172.45	3.94	1353	3.89	34.83
1999-2000	123.11	-0.34	203.41	1.80	1652	2.21	43.88
2009-10	123.61	0.04	232.36	1.42	1879	1.37	48.12
2019-20	126.67	0.25	292.86	2.60	2312	2.30	52.16

Table-3 Presents the three yearly moving averages of area sown, production and yield for foodgrains. It is observed that area sown has constantly increased from 115.39 M hectare in 1959-60 to 127.43 M hectare during 1989-90 and then there is declined in area in 1999-2000 (123.11 M hectare). The production has also increased from 78.11 M tones in 1959-60 to 292.86 in 2019-20. The productivity level has been 681 kg/ha during 1959-60 which has gone up to 2312 kg/ha during 2019-20. This table also shows annual growth rates during different periods. During 1959-60 to 1969-70 the highest growth rate in area sown i.e. 0.645% was observed which was declining constantly up-to 1999-2000. The production level has shown positive growth rates per annum during all the periods. The growth rate has been highest at the level of 3.94 % per annum during 1979-80 to 1999-2000 and lowest i.e. 1.42% during 1999-2000 to 2009-10 In case of yield, the highest growth rate was observed during 1979-80 to 1989-90 (i.e. 3.89%) and lowest (1.37%) during 1999-2000 to 2009-10.

Table - 4 Presents the projected Net Sown area and Net Irrigated area for 2025-26. It is seen that the projected Net Sown area will be 138.94 M ha in 2025-26. The Net Irrigated area has been estimated of the order of 75.15 M ha in 2025-26 .

Table –4 Projected Net Sown Area, Net Irrigated Area

	2025-26
Net Sown Area (M ha)	138.94
Net Irrigated Area (M ha)	75.15

Table - 5 Projected per capita water availability

Year	Population (Million)	Per capita water availability (cubic metre)
1951	361	5177
2001	1027	1820
2025(projected)	1394	1341

Table -5 Presents the projected per capita water availability for 2025. It is seen that the projected water availability will be 1341 cubic metre in 2025.

Table -6 Presents the projected area sown, production and yield for Foodgrains for 2025-26. It is seen that the production has been estimated of the order of 284.52 M Tones in 2025-26. The area will be 120.37 in 2025-26 the projected yield will be 2325 kg per ha in 2025-26.

Table –6 Projected Area, Production and Productivity for Foodgrains

	2025-26
Production (M Tones)	284.52
Area (M ha)	120.37
Yield (Kg per ha)	2325

Table -7 Presents the projected per capita net availability of foodgrains for 2025-26. It is seen that the estimated per capita net availability of foodgrains will be 413 grams per day in 2025-26. Whereas projected per Capita net Availability of foodgrains per Annum will be 151 kg in 2025-26.

Table-7 Projected per capita net availability of Foodgrains

	2025-26
Per Capita net Availability of foodgrains per day (Grams per day)	413
Per Capita net Availability of foodgrains per Annum (Kg per year)	151

Concluding Note

Water is one of the most essential natural resources for sustaining life and it is likely to become critically scarce in the coming decades, due to continuous increase in its demands, rapid increase in population and expanding economy of the country. The availability of water resources may be further enhanced by rejuvenation of dying lakes, ponds and tanks and increasing the artificial means of ground water recharge. Water, being the most important resource for survival, should be conserved. The Government as well as the common masses has to work hand in hand in order to conserve water. To meet the targeted production, we have to manage the existing water resources and other related inputs such as fertilizer, pesticides, seed, and credit to farmers, crop insurance and latest technology in optimal manner.

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Chapter - 11

Effects of Air Pollution on Human Health

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Abstract- Hazardous chemicals escape to the environment by a number of natural and/or human activities and may cause adverse ef ects on human health and the environment. Increased combustion of fossil fuels in the last century is responsible for the progressive change in the atmospheric composition. Air pollutants, such as carbon monoxide (CO), sulfur dioxide (SO2), nitrogen oxides (NO), volatile organic compounds, ozone (O3), heavy metals, and respirable particulate matters has both acute and chronic ef ects on human health, af ecting a number of dif erent systems and organs. It ranges from minor upper respiratory irritation to chronic respiratory and heart disease, lung cancer, acute respiratory infections in children and chronic bronchitis in adults, aggravating pre-existing heart and lung disease, or asthmatic attacks. In addition, short- and long-term exposures have also been linked with premature mortality and reduced life expectancy. The paper discusses effects of air pollutants on human health and their mechanism.

Introduction

Air pollution is a major public health problem. A significant number of epidemiological studies have found a correlation between air quality and a wide variety of adverse health impacts emphasizing a considerable role of air pollution in the disease burden in the general population ranging from subclinical effects to premature death. Health risk assessment of air quality can play a key role at individual and global

health promotion and disease prevention levels. Global burden of disease data reveals more than one million premature deaths attributable to ambient air pollution in 2015 in India. More than one million additional deaths can be attributed to household air pollution. Particulate matter with diameter 2.5 μm or less has been causatively linked with most premature deaths. Acute respiratory tract infections, asthma, chronic obstructive pulmonary disease, exacerbations of preexisting obstructive airway disease and lung cancer are proven adverse respiratory effects of air pollution. Targeting air quality standards laid by WHO can significantly reduce morbidity and mortality because of air pollution in India.

Common Air Pollutants

Common air Pollutants are:

Particulate matter: Particulate matter (PM) refers to inhalable particles, composed of sulphate, nitrates, ammonia, sodium chloride, black carbon, mineral dust or water. PM can be of different size and is generally defined by their aerodynamic diameter, with PM2.5 and PM10 the most common in the regulatory framework and relevant for health. Sources of the largest particles called coarse particles (particles with diameter between 2.5 μm and 10 μm) will mainly consist of pollen, sea spray and wind-blown dust from erosion, agricultural spaces, roadways and mining operations. The finer particles (i.e., PM2.5) can be derived from primary sources (e.g., combustion of fuels in power generation facilities, industries or vehicles) and secondary sources (e.g., chemical reactions between gases). The greatest source of particulate matter around the home is generally the combustion of polluting fuels in open hearths or poorly vented, inefficient stoves or space heaters. In addition to household activities like cooking, space heating, and lighting, other activities can be important sources of particulate matter pollution in the home environment.PM is capable of penetrating deep into the lung and enter the bloodstream causing cardiovascular (ischaemic heart disease), cerebrovascular (stroke) and respiratory impacts.

Nitrogen Dioxide: Nitrogen dioxide (NO2) is a reddish-brown gas that is soluble in water, and a strong oxidant. Ambient sources of NO2 results from high temperature combustion of fuels in processes such as those used

for heating, transportation, industry and power generation. Household sources of nitrogen oxides (NOx) include equipment that burn fuels such as furnaces, fireplaces and gas stoves and ovens. Exposure to nitrogen dioxide can irritate airways and aggravate respiratory diseases. NO2 is an important ozone precursor, a pollutant closely linked to asthma and other respiratory conditions.

Ozone: Ground-level ozone (O3) is a major component of smog. It is formed from photochemical reactions with pollutants such volatile organic compounds, carbon monoxide and nitrogen oxides (NOx) emitted from vehicles, and industry. Due to the photochemical nature, the highest levels of ozone are seen during periods of sunny weather. It is worth mentioning that ozone can also be generated by household equipment, such as portable air cleaners. Exposure to excessive ozone can cause problems breathing, trigger asthma, reduce lung function and lead to lung disease.

Carbon monoxide: Carbon monoxide (CO) is a colourless, odourless gas produced by the incomplete combustion of carbonaceous fuels such as wood, petrol, coal, natural gas and kerosene in simple stoves, open fires, wick lamps, furnaces, fireplaces. The predominant source of carbon monoxide (CO) in ambient air is from motor vehicles.Carbon monoxide diffuses across the lung tissues and into the bloodstream, making it difficult for the body's cells to bind to oxygen. This lack of oxygen damages tissues and cells. Exposure to carbon monoxide can cause difficulties breathing, exhaustion, dizziness, and other flu-like symptoms. Exposure to high levels of carbon monoxide can be deadly.

Sulphur Dioxide: Sulphur dioxide (SO2) is a colourless gas that is readily soluble in water. It is predominantly derived from the combustion of fossil fuels for domestic heating, industries and power generation.

Lead: Lead (Pb) and lead particulate compounds can be found in the home in contaminated dust from products such as paints, ceramics, pipes and plumbing materials, solders, gasoline, batteries, ammunition, and cosmetics. Lead can also be found in ambient air from vehicle exhaust of fuel with lead. Lead poses health risks of particular concern for children and pregnant women. The health impacts for children exposed to lead include behaviour and learning problems, lower IQ and hyperactivity,

slowed growth,hearing problems, and anemia. In rare cases, ingestion of lead can cause seizures, coma and even death. For pregnant women, health risks include reduced growth of the fetus and premature birth. Adults exposed to lead also have a higher risk of cardiovascular effects increased blood pressure, the incidence of hypertension, decreased kidney function and risk of reproductive problems in both men and women Exposure to SO2 is associated with asthma hospital admissions and emergency room visits.

Conclusions: There are significant adverse effects of air pollution on pulmonary health, especially for asthmatics and respiratory symptoms. There is need for public awareness and policies to improve air quality in cities.

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Chapter - 12

STATUS OF WOMEN IN INDIA (1947-1985)

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Abstract- It's undeniable that a Woman is the pillar of each family, a special component of each society, and many more. In respect of all this, the status of women in Indian society is asymmetric and unequal. A number of social reformers, politicians fight to uplift the state of women after Independence of India. This paper is a small view to express the status of women after Independence of India

Keywords: women, India, status, Independence, Jawaharlal Nehru

INTRODUCTION:

"It is impossible to think about the welfare of the world unless the condition of women is improved. It is impossible for a bird to fly on only one wing."— Swami Vivekananda

In the long history of humanity and its development in the propagation of the human race and in the social economy of the world; the woman has been an important factor as a man. She has all the potentialities for work, action, and achievement. However, in a complex society like India, the status of women is asymmetrical when it comes to equality in terms of gender, social, economy, religion, culture and various other areas. Britain came into India bringing with it western thoughts and ideas. Western contact began to influence Indian thought. Men like Raja Rammohan Roy arose who took up the cause of women's reforms

and liberation. He fought for the abolition of Sati in 1829, and the Brahmo Samaj, which he established taught absolute equality of men and women

2. Revolutionary changes have taken place in the position of women in India after independence. The Constitution of India provided for special steps to be taken by the government to improve the condition of women by separate institutions. Women's history is developing into a new era of research at a particularly existing time it has been stimulated by two related but essentially independent development the maturation of social history and the growth of an active women's movement. In India, a significant landmark in the field of women's studies was the publication in 1974 of towards equality; the report of the Committee on the Status of Women in India (CSWI).

3. NEHRU & WOMENS' STATUS: Dawn of Independence marked the beginning of the new era, Jawaharlal Nehru as the first Prime Minister of emergent India to bring about the more fundamental transformation in the structure of Indian society. So women like Sarojini Naidu, Hansa Mehta, Renuka Roy and Durgabai Deshmukh were involved by Nehru in the important task of constitution making.

4. India was a free nation now, but in reality, it was still a slave to a lot of narrow mentalities of the society. Where a man was allowed for polygamy, but a widow was not allowed even think of a remarriage. Women were also separated from the right in the property. To break this social jinx from women's life Nehru came up with Hindu code bill which was supported by Dr.B.R.Ambedkar but it was strongly opposed in the parliament and this led to the failure of independent India's first Hindu code bill. Later in 1952 after the first general elections, the bill was again reconstructed and the bill was broken into different parts. The Hindu Marriage Act 1955, the special Marriage Act 1954, the Hindu Succession Act 1956, Hindu Minority and Guardianship Act 1956, Hindu adoption and maintenance Act 1956 and the Dowry Prohibition Act 1961 and section 125 of The Criminal Procedure Code for the social measure enacted during the premiership of Jawaharlal Nehru. These Laws aim at emancipating Hindu women from oppression and affording them an equal status with a man.

5. WOMEN AFTER INDEPENDENCE: In Independent India, women have taken important political and administrative positions. For instance, Indira Gandhi guided the destiny of country as prime minister of India for more than 15 years. Women have also served as a presiding officer, chief ministers, ministers in the union and the state government, the presiding officer of legislative bodies and secretary to the Government of India. Vijayalakshmi Pandit was India's Ambassador to the Soviet Union and the first woman president of United Nations General Assembly. Najma Heptulla was the president of Council of the Inter-parliamentary Union.

6. Women in India participate in all activities such as education, politics, media, art and culture, service sector, science, and technology & etc. The Constitution of India guarantees to all Indian women equality no discrimination by the state (Article 15(1)); equality of opportunity (Article 16) and equality pay for equal work (Article 39 (D)). A very few were allowed into the public space which she was expected to manage on her own while maintaining her domestic role as homemaker. In spite of the Sharda Act which was passed in the 1950's to raise the marital age to 18 years for girls. For viable economic and social development to take place in any country, it is necessary that people participate in the political process. The percentage of women members of the Lok Sabha, the elected house of the Indian Parliament has ranged from a low of 2.8% in the first 1952 election, to a high of 8.5% in the 1984 election the average percentage of women number has been 5.6%. Women's participation in politics has not only emerged in national politics but there were special amendments for them to be an active part of the administration right from the root levels in rural areas with Gram Panchayat. The 73rd Amendment Act, 1992, mandating reservation in at least 1/3 rd of the seats of all Panchayat Councils and 1/3 rd of the Pradhan (head of the Panchayat) positions for women, was a landmark for women's political empowerment. This was followed by the 74th Amendment Act, 1992, which established similar reservations in Nagar Palikas & Municipalities.

WOMEN AND EDUCATION: In Independent India, education is seen as an agent of social change. The development strategy in independent

India in 1950 heavily on planning. The first five-year plan (1951-1956) held women have the same opportunity as men for taking all kind of work and this presupposes that they get the equal facility. The second five-year plan (1956-1961) laid greater emphasis on women. The third five-year plan (1961-1966) considered the need of increasing the proportion of women student in colleges, universities to take up different occupation. The fourth five-year plan (1969-1974) continued to give priority to education for the girl child. fifth five-year plan (1974-1979) higher priority was given to free and compulsory education for all children up to the age of 14. The sixth five-year plans (1980-1985) emphasized the need of universalisation of elementary education and promote balwadis to enable girls to attend school.

7. Women, who now represent 48.2% of the population, are getting access to education, and then employment. From 5.4 million girls enrolled at the primary level in 1950-51 to 61.1 million girls in 2004-05. At the upper primary level, the enrolment increased from 0.5 million girls to 22.7 million girls. Dropout rates for girls have fallen by 16.5% between the year 2000 and 2005. Programs like 'Sarva Shiksha Abhiyan' and 'Saakshar Bharat Mission for Female Literacy' has helped increase the literacy rates from less than 10 percent to more than 50% today. 8 The enrollment figure under the program of adult literacy for women has given by the Ministry of Education is 2 million in 1950-51; 3 million in 1960-1961; 6 million in 1965-66 and 3.2 million in 1968-69.

The ministers of agriculture, rural development, industries, labor, science and technology and the department of women and child development have taken significant initiatives by making specific women's employment. Government biggest effort to employment for women has been in the rural development sector. The most important programme in this connection was integrated rural development program which was started by way back in 1975. The target under the program however provided coverage andfisheries out of the total beneficiaries.

WOMEN AND SOCIETY: After the attainment of independence, it was felt that social and economic uplift of the masses required government assistance to strengthen the service rendered by voluntary agencies. The central government, therefore, creates a new agency the Central Social

Welfare Board in 1953 to promote welfare and development services for women and children. Both the Central Social Welfare Board and the department of community development concluded that the proper agency for the success of this program would be acommittee of local women. The organization of Mahila Mandal thus becomes one of the objectives of these rural development programs. Mahila Mandal was organized in the villages and blocks for promoting women's program nutrition, education, health and mother and child care, home improvement, literacy, recreation and cultural activities.

According to the report of the Committee on the Status of Women in India (1974), the number of female employees in the categories of professional, technical and related workers, primary and middle school teachers has been continuously rising since 1960. The Director General of Employment and Training data for selected professions in public and private sectors identify teaching, medical and health, clerical and related workers and telephone operators as the four occupations.

CONCLUSION: As the time changes women's right also have undergone wide changes. Indian women have mastered anything which a woman can dream of but still has to go a long way to achieve equal status in the minds of the Indian men. With the changes in policies, women have become more powerful in various fields. Women's equal participation in political life plays a pivotal role in the general process of the advancement of women. It is not only demand for simple justice or democracy but also can be seen as a necessary condition for women is interest to be taken into account. The term status includes not only personal and proprietary right but also include duties liabilities and disabilities.

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Chapter - 13

हिंदी उपन्यासों में पर्यावरण चेतना

डॉ क्रांति बोध
हिंदी विभाग,
एम एम एच कॉलेज, गाज़ियाबाद।

सामान्य अर्थ में पर्यावरण का आशय पौधों एवं पालतू जानवरों को समाहि त करतेहुए हमारे चारों ओर के समग्र संसार से है। व्यापक अर्थ मेंस्थलमण्डल वायुमण्डल, जैवमण्डल के द्वारा सामूहि क रूप से पर्यावरण का निर्माण हुआ हैजि सके अन्तर्गत वायु. भूमि जल, वन्य पक्षियों, मछलियों और वनों इत्यादि को सम्मिलित किया जाता है। जो वातावरण के भौति क संघटक है। लेकिन महत्वपूर्ण सामाजि क एवं मानवीय पक्षों यथा- मानवीय कल्याण, सामाजिक न्याय, सुरक्षा, स्वास्थ्य, शिक्षा, संस्कृति, उपलब्ध व्यवसाय और स्वच्छ वातावरण को समाहित कि ये बिना पर्यावरण अपूर्ण है। भारत जैसे देश में जहां देश की एक बडी जनसंख्या गरीबी रेखा के नीचे जीवन यापन कर रही है, इन पक्षों का महत्व और भी बढ जाता है। पर्यावरण को भिन्न-भिन्न वैज्ञानिकों ने भिन्न-भिन्न नियमों एवं मतों के अनुसार परिभाषित किया है जिन में इन साइक्लोपिडिया ब्रिटेनिका (1943-1973) के अनुसार सम्पूर्ण वाह्य प्रभाव जो प्रकृति की भौति क एवंजैवीय शक्ति यों के रूप में वस्तुओं के समूह अथवा एकाकी वस्तुके प्रतिसक्रिय है. पर्यावरण के अन्दर समाहित है जबकि सओ्नले (1966) के अनुसार पर्यावरण की रचना उन सभी वस्तुओं, दशाओं एवं शक्ति यों द्वारा होती है जिनसे जीवित पदार्थ प्रभावित होता है तथा प्रतिक्रिया करता है। यद्यपि इसकी तीव्रता एवं दिशा परिवर्तनशील है।

विज्ञान और टेक्नोलॉजी के सहारे मनुष्य जिस प्रकार अपनी सफलता की सीढ़ियाँ चढ़ता जा रहा है और उसी रफ़्तार में प्रकृति के साथ अप्राकृति क ज्यादती कर अपनी सफलता पर इतरा रहा है, उसका खामियाजा उसे विभिन्न आपदाओं व विभीषिकाओं के रूप में सामना करना पड़ रहा है। इसी कारण आज सम्पूर्ण विश्व में परिस्थिति की संकट गम्भीर मुद्दा बन चुका है। विगत दो-तीन दशकों में परिस्थितिकीय संकट को लेकर भूमंडलीकरण एवं उदारीकरण के नाम पर विकास का तांडव मचा हुआ है। पर्यावरण असंतुलन के सम्बंध में वी.एन. एवं जनमेजय सिहं लिखते हैं- आधनिक भौतिकतावादी

सस्ंकृति और सभ्यता के विकास ने देश के सम्पदा में श्रीवृद्धि की है। आद्यौगि क, नगरीकरण, यंत्रीकरण के प्रगति के साथ साथ विशालकाय मिल, फैक्टरी कारखाने भी स्थापित हुए। कृषि में विज्ञान का प्रवेश हुआ, वैज्ञानिक ढंग से खेती करने के कार्य में वृद्धि हुई। इन सब ने मिलकर प्राकृति क पर्यावरण को नष्ट भ्रष्ट कर दिया है।'

विश्व के समस्त देशों ने पर्यावरण-विमर्श को महत्व देकर इस असंतुलन को कम करने के लिए कई सन्धियाँ की हैं तथा उसका पालन करने के लिए वचनबद्ध हैं। किन्तु "अभी कुछ दिनों पहलेअमेरि का ने 'पेरिस जलवायु समझौता' से खुद यह कहते हुए अलग कर लिया कि इससे अमेरिका का अहित होगा। .... जबकि संयुक्त राज्य अमेरिका में प्रति व्यक्ति गैस उत्सर्जन भारत के बीस गुना है।"

औद्योगीकरण और बाजारीकरण के इस युग में निरन्तर उग रहे कंकरीट के जंगलों ने पर्यावरण को अत्यधिक क्षति पहुँचाई है। उद्योग स्थापि त करने तथा बहुमंजिली ईमारतें बनाने के लिए निरन्तर पेड़ों का कटान हो रहा है। व्यापार के लिए तस्कर भी पेड़ों को अवैध रूप से काट रहे हैं। अगर इसी तरह वृक्षों का कटान होता रहा तो एक समय ऐसा आयेगा जब हमें जीवित रहने के लि ये ऑक्सीजन सिलेंडर की आवश्यकता पड़ने लगेगी; क्योंकि तब प्राणवायु के लि ये धरती पर वृक्ष शेष ही नहीं बचेंगे। भारतीय साहित्य और दर्षन स्वयं में संपूर्ण रूप से पर्यावरण केन्द्रित रहे हैं। पर्या वरण कोई आधुनि क संप्रत्यय नहीं है वरन्वैदिक काल से निरंतर चला आ रहा है। वैदिक काल के अध्ययन से पता चलता है कि तत्कालीन सभ्यता के व्यक्ति प्रकृति की पूजा करतेथे। उनके लिए पृथ्वी उनकी माता थी जिसकी रक्षा के लिए तथा जिस पर जीवन बनाए रखने के लिए वे अपने सभी कर्त्तव्यों का पालन करते थे। वैदिक युग के लोग पौधों जैसे- तुलसी, बरगद, पीपल आदि की पूजा करते थे जिससे वे उनके औषधीय गुणों को नष्ट होने से बचा सके तथा इस प्रकार पर्यावरण को बुद्ध रख सके। उनके व प्रकृति के मध्य माता-पुत्र का पवित्र संबंध था जिसका वर्णन हजारी प्रसाद द्विवेदी जी के 'कुटज' में भी मिलता है,

"यह धरती मेरी माता है और मैं इसका पुत्र हूँ। इसीलिए मैं सदैव इसका सम्मान करता हूँ और मेरी धरती माता के प्रति नतमस्तक हूँ।"

अग्नि, नदी, वृक्ष, सूर्य, पशु-पक्षी सारे पूजनीय रहे हैं। यूरोप की तुलना में भारतीय संस्कृति हमेशा प्रकृति से सामंजस्य बैठाती आई है, किन्तु यूरोप की औद्योगिक क्रांति, पूंजीवादी विकास, वैज्ञानिक उन्नति, विश्व युद्ध, शीत युद्ध, ओजोन क्षरण, परमाणु परीक्षण, वैश्वीकरण आदि ने प्रकृति के साथ हमारे रिश्तों को नष्ट कर दिया है। मानव जाति की एकपक्षीय विकास ने प्रकृति को बहुत नुकसान पहुँचाया है। आज हमारे चारों तरफ महामारी फैली हुई है, न साँस लेने के लि ए शुद्ध वायु, न पीने के लिए शुद्ध जल मिल पा रहा है,

ओजोन होल लगातार फैल रहा है, ग्लेशियर पिघल रहा है, पृथ्वी का तापमान बढ़ रहा है, खाद्य वस्तुएँ विषाणु युक्त हो गई हैं, हमारे लिए पर्यावरण को बचाने की बड़ी जिम्मेदारी आ पड़ी है। यही पर्यावरण विमर्श की आधार भूमि है।

हिन्दी साहित्य सदैव दर्षन से प्रभावित रहा है। अतः प्रकृति के प्रति प्रेम, संरक्षण, आत्मानुभूति तथा किसी को भी हानि न पहुँचाने का भाव (चाहे वह मनुष्य हो या पर्यावरण) हिन्दी साहित्य में बहुतायत से पाया जाता है। हिन्दी साहित्य में प्रारम्भ से ही प्रकृति के अनावष्यक दोहन-पोषण का विरोध किया गया है। हिन्दी के सभी कवि यों जैसे- कबीर, रवि दास, गुरुनानक आदि तथा साहित्यकारों जैसे हजारीप्रसाद द्विवेदी, आचार्य रामचंद्र षुक्ल, आचार्य महावीरप्रसाद द्विवेदी आदि ने प्रकृति के अनावष्यक षोषण के विरुद्ध आवाज उठाकर मनुष्य को आत्मानुभूति की ओर प्रेरि त कि या। जहाँ हिन्दी साहित्य में आदि काल (संवत्1050) से लेकर रीति काल (संवत्1900) तक कि सी न कि सी रूप में कवियों ने काव्य में प्रकृति एवं पर्यावरण को वर्णित किया है, वहीं आधुनिक काल (संवत्1900 सेआज तक) से छायावादी काव्यों में पर्यावरण के प्रति प्रौढ़ता दृष्टि गोचर होने लगती है। छायावादी काव्य, जिसे आचार्य रामचंद्र षुक्ल नेनई काव्यधारा का तृतीय उत्थान कहा है, में प्रकृति सम्बन्धी कविताओं के बाहुल्य और उस में प्रति फलित प्रकृति परक दृष्टिकोण को देखकर कुछ विचारकों ने छायावाद को 'प्रकृति काव्य' भी कहा है। इस काल के छायावादी कवियों मैथिलीशरण गुप्त, मुकुटधर पाण्डे, नन्ददुलारे वाजपेई, सुमित्रानंदन पंत, सूर्यकान्त त्रिपाठी निराला, महादेवी वर्मा, हरिवंशराय बच्चन आदि ने अपने काव्य में प्रकृति एवं पर्यावरण सौन्दर्य का चित्रण सुन्दरता के साथ किया है। इसे आधुनिक काल या गद्यकाल का एक परिवर्तित युग भी कहा जाता है। हिन्दी गद्य में आचार्य हजारी प्रसाद द्विवेदी के निबंध भी पर्यावरणीय समस्याओं को व्यक्त करने का सुन्दर माध्यम रहे हैं। उन्होंने न केवल पर्यावरण के अनुचित दोहन व प्रदूषण के विषय में लिखा, अपितु पर्यावरणीय स्रोतों के उचित उपयोग व संरक्षण के विषय में महत्त्वपूर्ण सुझाव व निर्देष भी दिये। 'आम फिर बौरा गए', 'अशोक के फूल', 'मनुष्य का भविष्य' आदि निबन्धों में जलवायु परि वर्तन, ग्लोबल वार्मिंग, जल और वायु प्रदूषण तथा मनुष्य के आत्मकेन्द्रित दृष्टिकोण पर उनका चिन्तन दर्शनीय है।

साहित्य और समाज में गहरा सम्बंध है। अतः जीव और जगत की कोई भी समस्या या असंगति साहित्य के परिधि से बाहर नहीं है। एक सच्चा साहित्यकार अपने अनुभव से बाहर जाकर सामाजिक सरोकारों को अपने चितंन का विषय बनाता है। एक साहित्यकार समाजविज्ञानी की तरह वर्तमान समाज की विभीषिकाओं से लड़ने के लिए वैचारिक आंदोलन शुरू करता है। गत दो-तीन दशकों में लि खे गए कुछ उपन्यास इस प्रकार हैं – मरंगगोड़ा नीलकंठ हुआ-2012 (महुआ माजी), रह गईं दिशाएँ इसी पार (संजीव) -2011, एक ब्रेक के बाद (अलका सरावगी) - 2008 तथा कुईया जान - 2005, (नासिरा शर्मा)।)

रह गईं दिशाएँ इसी पार - यह संजीव का एक विस्तृत फलक वाला उपन्यास है। इस उपन्यास में संजीव आद्यौगिक सभ्यता के संकटों को न केवल चिन्हित करते हैं बल्कि मनुष्य के भीतर की निरंकुश उपभोक्तावादी मानसिकता के फलस्वरूप उपजे खतरों की ओर इंगित भी करते हैं। आज बाजार ने मनुष्य की आत्मा पर कब्जा करके उसे अमानुष बना दिया है। अपनी चेतना जीवंतता और निजता से शून्य वह केवल प्रोडक्ट सा रह गया है। उपन्यास में संजीव की चिंता इस बात को लेकर है कि जीव वैज्ञानिक द्वारा क्लोनिगं और जेनेटिक्स के क्षेत्र में होने वाली अभूतपूर्व उपलब्धियों को वे मानवीय सम्बन्धों के संसार में उत्पन्न होने वाले विकृतियों की संज्ञा देते हैं। जीवन मृत्यु, काम व प्रजनन, पदार्थ और अध्यात्म की रहस्यमय गुत्थियाँ सुलझाकर मनुष्य ने अनावश्यक हस्तक्षेप किया है।

एक ब्रेक के बाद: इस उपन्यास में अलका सरावगी ने यह उद्घाटित कि या है कि किस प्रकार मल्टीनेशनल कंपनियाँ आद्यौगिक विकास के नाम पर प्राकृतिक संसाधनों का बेतहाशा दोहन करती हैं तथा इसी क्रम में तीसरी दुनिया के देश उनके लिए 'रॉमटेरियल' उपलब्ध कराने के बाजार हैं या कचरे के डपिंगं स्टेशन के रूप हैं। इन सबके फलस्वरूप जब दनिुया में ग्लोबल वार्मिंग के खतरे मडंराने लगे हैं तो लोगों को प्रकृति व पर्यावरण सरंक्षण की चिंता सताने लगी है। इसके समाधान के लिये भी बहुराष्ट्रीय कंपनियाँ तीसरी दुनिया की ओर नजर गड़ाए बैठी है। उनकी गरीबी इन कम्पनियों के लिए चारागाह है। वह इनके लि ए वरदान साबित होती है। "शोषण करनेव कचरा फेंकने के अलावा अब वे अपने 'पाप' बेंचने का व्यापार भी यहां खूब चला सकते हैं। कार्बन क्रेडिट की खरीद-फरोख्त करके। के. वी. जैसे लोग देशी साहब इन कम्पनियों के वफादार एजेंट हैं। वे जानते है कि हवा में एक टन कार्बनडाइऑक्साइड कम करने के लिए एक काबन क्रेडिट मिलता है जिसे विदेशों में दस से तीस यूरो में बेचा जा सकता है। हींग लगे न फिटकिरी रंग चोखा हो जाय। के. वी. कार्बन क्रेडिट जमा करने के लिए कम्पनी खोलते हैं - करबोवेज सिस्टम्स इंक।" बड़ेही निस्संग व स्पष्ट ढंग से अलका सरावगी जी सस्टेनेबल वि कास और रिन्यूएबल एनर्जी का उपयोग पृथ्वी को बचाने के लिए कि ये जाने वाले मानवीय प्रयत्नों के संदर्भ में नवउपनि वेशवादी शक्तियों के साम्राज्य को कायम रखने की जुगतों का पर्दा फाश करती हैं- "भई, आप फैक्टरि याँबन्द मत कीजिए, बेशक हवा में कार्बन छोड़ते रहि ये। बस, जैसे आप स्टील फैक्टरी के लि ए लोहा खरीदते रहते हैं, वैसे ही कार्बन क्रेडिट खरीद लीजिए। पूरी धरती का आसमान तो एक ही है, आप कहीं हवा-पानी बिगाड़ि ये, पर कहीं और कि हवा- पानी सुधार दीजिए। दिक्कत क्या है?"

नासिरा शर्मा का उपन्यास 'कुईयाजान' जल संकट की गम्भीर समस्या को लेकर लि खा गया एक सशक्त उपन्यास है। बांधों के नि र्मा ण का प्रभाव न केवल मनुष्य बल्कि पशु-पक्षियों पर भी पड़ रहा है जिसके कारण इन सबो को विस्थापित होना पड़ रहा। बांग्ला देश में बने फरक्का बांध से इस नुकसान का सजीव चित्रण नासिरा जी ने ' कुईयाजान' में इस प्रकार किया है - 'इस बैराज के बनने से बंगला देश

के कुटि या सहित सात और जिलों में जलस्तर काफी नीचे चला गया जिसके कारण पेड़- पौधों पर बुरा असर पड़ा। जमीन का लवण भी जल के साथ नीचे चला गया। सुंदरी पेड़ जिसकी हमारे यहाँ बहुतायत थी, जिसके कारण जगंल का नाम सुंदरवन पड़ा, वह पेड़ अब खोजने से ही नजर आता है। वही हाल मछलि यों का हुआ। प्रवासी पक्षियों के आगमन पर असर हुआ। प्राकृति क संसाधन सीमि त है। स्वार्थ में मनुष्य इतना अँधा हो चुका है कि आने वाली पीढ़ी की उसे कोई चिंता नहीं।

महुआ माजी द्वारा लिखित 'मरंगगोड़ा नीलकंठ हुआ' उपन्यास की मूल समस्या प्रदूषण, विकिरण और विस्थापन की है। आदि वासि यों का प्रकृति के साथ गहरा संबंध है किंतु आज उसका अस्तित्व खतरे में नजर आता है। विकिरण की समस्या पर आधारित यह हिंदी का प्रथम उपन्यास माना जाता है। झारखंड के आदि वासी बहुल क्षेत्रों में बहुराष्ट्रीय कम्पनियों द्वारा कि ये जा रहे उत्खनन का वहां के जल, जमीन और जंगल को किस प्रकार दूषित कर रहे हैं इसका शोधपूर्वक वर्णन महुआ माजी नेअपनेउपन्यास 'मरंग गोड़ा नीलकंठ हुआ' में किया है। यूरेनियम उत्खनन के दुष्प्रभाव को लेकर लि खेगए इस उपन्यास में पर्यावरणीय समस्या के साथ आदि वासी समस्या तथा बाहरी लोगों के हस्तक्षेप सेहो रहेपरि वर्तनों को भी दर्शाया गया है। खनिज संसाधन को निकालने हेतु सरकार द्वारा लाईसेंसधारी बड़ी-बड़ी कम्पनियाँ अपने विशाल मशीनों द्वारा धुआं, कचरों द्वारा वहाँ की नदियों तथा वातावरण को प्रदषिूत कर रही है।

शिक्षित व शहरी समझेजाने वाले लोगों की तुलना में अशि क्षि त व ग्रामीण जनता पर्यावरण संरक्षण के प्रति अधिक जागरूक है। कुसुम कुमार का उपन्यास 'मीठी नीम' वृक्ष संरक्षण व वृक्षारोपण आंदोलन पर आधारि त है। उपन्यास की नायिका अशिक्षित ओमना का पर्यावरण प्रेम समाज के लिए मिसाल बनता है। वह वृक्षों की देखभाल करने के कारण अपने बेटे के साथ अपने नवजात पौत्र को देखने नहीं जाती है। उसकी बेटी भी यह प्रण लेती है. 'एक बात कसम खाकर कहती हूँ मैं जहां रहूंगी, वृक्षों की रक्षा करूंगी।' ओमना वृक्षों को पुत्रवत प्रेम करती है। प्राकृतिक संसाधन सीमित हैं और जिस प्रकार हम उसका अंधाधुध दोहन कर रहे हैं उससे वह दिन दूर नहीं जब समस्त गोचर-अगोचर प्राणी सकंट में पड़ जाएंगे। विकास के पूँजीवादी मॉडल पर चलने वाले देश में वि कल्प मॉडल की खोज करना होगा, तभी मानव अस्तित्व कायम रहेगा। आज मानवीय क्रि या-कलापों के दद्वारा पर्या वरण के सन्तुलन में विशेष अंतर हो जाता है। वनों का वि नाश करना सबसे अधि क हानि कारक है। वनों के कट जाने से पर्यावरण के सन्तुलन पर सबसे अधिक प्रभाव पड़ा है। मानवीय क्रि याओंसेबाढ़ आना और भूमि का मरुस्थलीय रूप लेना भी मुख्य कारणों में से एक है। आधुनिक युग में तकनीकी विकास के माध्यम सेकुछ पारि स्थितिकीय समस्याओंका जन्म हुआ है। ऐसे कुछ कारण इस प्रकार है-

1. शहरीकरण, जनसंख्या वृद्धि, मृत्युदर में कमी आदि का पर्यावरण पर प्रभाव पड़ चुका है।
2. तकनीकी शिक्षा के प्रसार से अनेक पर्यावरणीय प्रदूषणों का जन्म।

3. तीव्र गति से वनोन्मूलन
4. परिवहन द्वारा वायु प्रदूषण का विस्तार आदि।

इन कारणों के अतिरिक्त और भी मानव द्वारा किये गये ऐसे कारण है जिनसे पारिस्थितिक-तन्त्र का सन्तुलन पूर्णतः बिगड़ गया है। प्रदूषण के प्रति भय की भावना पैदा करना जरूरी है। प्रचार माध्यमों से जनता को पर्या वरण के प्रति जागरुक बनाना जरूरी है।

सबसे बड़ी बात तो यह हैकि हमें यह समझना है। कि पृथ्वी के जो संसाधन है, सीमित है और उनके उपभोक्ता बहुत हैं।

हिन्दी के मशहूर कथाकार संजीव ने इस भीषण समस्या को अपने उपन्यासों के माध्यम से प्रस्तुत करने का प्रयास कि या है। उन्होंने अपने उपन्यासों के माध्यम से एक नई ज़मीन टूटती है। 'कि सनगढ़ के अहेरी', 'सर्कस', 'सावधान! नीचे आग है', 'धार', 'पाँव तले की दूब', 'जंगल जहाँ शुरू होता है', 'सूत्रधार' जैसे उपन्यासों में उन्होंने नवीनता ही ढूँढी है। उनके उपन्यासों का कथ्य पिछड़े अंचलों की त्रासदी, जनजातीय अभिशप्त जीवन, औद्योगीकरण के तहत होने वाला वि स्थापन, दलित चेतना, लोकजीवन और लोक संस्कृति से जुड़े विभिन्न सन्दर्भों को उजागर करता है। 'सावधान ! नीचे आग है', 'धार', 'पाँव तले की दूब' और 'आकाशचम्पा' में विकास परि योजनाओं के परिणामस्वरूप उत्पन्न पर्यावरणीय समस्याओं का जीवन्त चित्र उपस्थित कर संजीव यह बताना चाहते हैं कि हमें प्रगति का सहारा तो अवश्य चाहिए। लेकिन इसके लिए प्राकृति क संपदाओं का बड़े पैमाने पर उपभोग एक भारी चूक होगा। इसी के साथ वे मानव समाज की बेहतरी के लिए, आगामी पीढ़ी के उज्ज्वल भविष्य के लिए प्राकृतिक संसाधनों के उपभोग मेंसावधानी बरतने की चेतावनी भी देते हैं। नदियों पर बड़े-बड़े बाँधों के निर्माण ने नदियों की गति रोक दी है, जहाँ विकास के लिए बड़े-बड़े बाँधों का निर्माण आवश्यक है, वहीं इसके कई दुष्परिणाम देखे जा सकते हैं। जिस देश में नदी को ईश्वर मान कर पूजा जाता है, उसी देश में नदी की ऐसी दुर्गति हो रही है। कारखानों से लेकर घरों तक की सारी वर्जित चीजें नदी में ही फेंकी जाती है। बड़े-बड़े शहरों के कचरों से भरे नाले के मुहाने नदी पर ही जाकर खुलते हैं। एस. हारनोट की कहानी 'एक नदी तड़पती है' में विकास के नाम पर बाँधों के निर्माण एवं उससे लोगों के वि स्थापन के साथ ही साथ एक नदी के तड़प कर मरने की व्यथा दिखाई गई है। कि स प्रकार कम्पनी के बड़े बाबुओं और नेता ओंने आधुनिक यंत्रों के साथ नदी पर बेरहम आक्रमण शुरू कर दि या और नदी तड़प-तड़प कर मरने लगी। कहानी में लेखक लिखते हैं- नदी धीरे- धीरे कई मीलो तक घाटि यों में जैसे स्थिर व जड़ हो गई थी। उसका स्वरुप कि सी भयंकर कोबरे जैसा दिखाई देता था मानो कि सी ने उसकी हत्या करके मीलों लम्बी घाटी में फेंक दिया हो। अब न पहले जैसा बहते पानी का नदी-शोर था न ही कोई हलचल।

समकालीन साहित्य में पर्यावरण चेतना के स्वर तो सुनायी पड़ते हैं मगर बहुत ही धीमेसुर में अभी इस समस्या को सतही तौर पर ही लिया जा रहा है मगर यह मामला बहुत ही गंभीर है और गंभीर चितंन और बेबाक अभिव्यक्ति की मांग करता है। महानगर गैस के चैम्बर बन गए हैं और मनुष्य की लालची सोच, सीमित सोच और असंवेदनशीलता नेनयी पीढ़ी के लोगों को असमय ही बीमारियों के चंगुल में धकेल दिया है। ज़हरीले वातावरण में रहकर जीवन कैसे सुरक्षित रह सकता है ? जब जीवन ही नहीं रहेगा तब जीवन और जीवन के वि विधरंगों की बात करना मायने नहीं रखता। स्त्री विमर्श, दलित विमर्श, आदिवासी विमर्श आदि की बात तभी आगे बढ़ सकती है अगर हमारा जीवन सुरक्षित होगा और इसके लिए पर्यावरण को बचाना और समाज को अपने प्राकृतिक वातावरण को बचाने के लिए संवेदनशील बनाना साहित्यकारों का दायित्व है और विशेषकर समकालीन कथाकार महत्वपूर्ण भूमिका निभा सकते हैं। अतः आज का साहित्य इस गंभीर मसले को मुख्य विषय बनाकर अपनी अहम् भूमिका निभा सकता है।

Chapter - 14

जैव विविधता संरक्षण : औचित्य और विधियां

प्रो डॉ किरण खन्ना
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जैव विविधता भारतीय समाज में जीवन और विविधता के संयोग से निर्मित शब्द है जो आम तौर पर पृथ्वी पर मौजूद जीवन की विविधता और परिवर्तनशीलता को संदर्भित है। संयुक्त राष्ट्र पर्यावरण कार्यक्रम (युएनईपी), के अनुसार जैवविविधता biodiversity विशिष्टतया अनुवांशिक, प्रजाति, तथा पारिस्थितिकि तंत्र के विविधता का स्तर मापता है। भारत में पर्यावरण संरक्षण का इतिहास बहुत पुराना है। हडप्पा संस्कृति पर्यावरण से ओत-प्रोत थी, तो वैदिक संस्कृति पर्यावरण-संरक्षण हेतु पर्याय बनी रही। भारतीय मनीषियों ने समूची प्रकृति ही क्या, सभी प्राकृतिक शक्तियों को देवता स्वरूप माना। ऊर्जा के स्त्रोत सूर्य को देवता माना तथा उसको 'सूर्य देवो भव' कहकर पुकारा। भारतीय संस्कृति में जल को भी देवता माना गया है। सरिताओं को जीवन दायिनी कहा गया है, इसीलिए प्राचीन संस्कृतियां सरिताओं के किनारे उपजीं और पनपी। भारतीय संस्कृति में केला, पीपल, तुलसी, बरगद, आम आदि पेड पौधों की पूजा की जाती रही है। मध्यकालीन एवं मुगलकालीन भारत में भी पर्यावरण प्रेम बना रहा।

स्वतंत्र भारत में पर्यावरण नीतियां तथा कानून

भारतीय संविधान जिसे 1950 में लागू किया गया था परन्तु सीधे तौर पर पर्यावरण संरक्षण के प्रावधानों से नहीं जुड़ा था। सन् 1972 के स्टॉकहोम सम्मेलन ने भारत सरकार का ध्यान पर्यावरण संरक्षण की ओर खिंचा। सरकार ने 1976 में संविधान में संशोधन कर दो महत्त्वपूर्ण अनुच्छेद 48 ए तथा 51 ए (जी) जोड़ें। अनुच्छेद 48 ए राज्य सरकार को निर्देश देता है कि वह 'पर्यावरण की सुरक्षा और उसमें सुधार सुनिश्चित करे, तथा देश के वनों तथा वन्यजीवन की रक्षा करे'। अनुच्छेद 51 ए (जी) नागरिकों को कर्तव्य प्रदान करता है कि वे 'प्राकृतिक पर्यावरण की रक्षा करे तथा उसका संवर्धन करे और सभी जीवधारियों के प्रति दयालु रहे'। स्वतंत्रता के पश्चात बढते औद्योगिकरण, शहरीकरण तथा जनसंख्या वृद्धि से पर्यावरण की गुणवत्ता में निरंतर कमी आती गई। पर्यावरण की गुणवत्ता की इस कमी

में प्रभावी नियंत्रण व प्रदूषण के परिप्रेक्ष्य में सरकार ने समय-समय पर अनेक कानून व नियम बनाए। इनमें से अधिकांश का मुख्य आधार प्रदूषण नियंत्रण व निवारण था। पर्यावरणीय कानून व नियमके अन्तर्गत जैव विविधता संरक्षण हेतु कुछ नियम बनाए गए जिसका संक्षिप्त परिचय निम्नलिखित हैं:

वायु (प्रदूषण निवारण एवं जैव-विविधता संरक्षण अधिनियम, 2002 ::

भारत विश्व में जैव-विविधता के स्तर पर 12वें स्थान पर आता है। अकेले भारत में लगभग 45000 पेड-पौधों व 81000 जानवरों की प्रजातियां पाई जाती है जो विश्व की लगभग 7.1 प्रतिशत वनस्पतियों तथा 6.5 प्रतिशत जानवरों की प्रजातियों में से है। जैव-विविधता संरक्षण हेतु केंद्र सरकार ने 2000 में एक राष्ट्रीय जैव-विविधता संरक्षण क्रियानवयन योजना शुरु की जिसमें गैर सरकारी संगठनों, वैज्ञानिकों, पर्यावरणविदों तथा आम जनता को भी शामिल किया गया। इसी प्रक्रिया में सरकार ने जैव विविधता संरक्षण कानून 2002 पास किया जो इस दिशा में एक महत्वपूर्ण कदम है। वर्ष 2002 में पारित इस कानून का उद्देश्य है-जैविक विविधता की रक्षा की व्यवस्था की जाए उसके विभिन्न अंशों का टिकाऊ उपयोग किया जाए, तथा जीव-विज्ञान संसाधन ज्ञान के उपयोग का लाभ सभी में बराबर विभाजित किया जाये। अधिनियम में, राष्ट्रीय स्तर पर जैव-विविधता प्राधिकरण बनाने का भी प्रावधान है, राज्य स्तरों पर राज्य जैव विविधता बोर्ड स्थापित करने, तथा स्थानीय स्तरों पर जैव-विविधता प्रबंधन समितियों की स्थापना करने का प्रावधान है ताकि इस कानून के प्रावधानों को ठीक प्रकार से लागू किया जा सके।

जैव विविधता कानून (2002) केंद्रीय सरकार को निम्न दायित्व भी सौंपता है ::

उन परियोजनाओं का पर्यावरणीय प्रभाव जांचना जिनसे जैव विविधता को हानि पहुचने की आशंका हो।

जैवतकनीकि से उत्पन्न प्रजातियों के जैव विविधता तथा मानव स्वास्थ्य पर पडने वाले नकारात्मक प्रभावों के लिए नियंत्रण तथा उपाय सुनिश्चित करना।

स्थानीय लोगो की जैव विविधता संरक्षण की परम्परागत विधियों की रक्षा करना।

जैव विविधता अधिनियम (2002) जैव विविधता संरक्षण सुनिश्चित करने की दिशा में एक महत्वपूर्ण कदम है।

यह सरकार के साथ-साथ आम लोगों की भागिदारिता भी सुनिश्चित करता है। यह सरकार को नीतिगत, संस्थागत तथा वित्तीय अधिकार प्रदान करता है। साथ ही यह सरकार को जैव विविधता की परम्परागत तकनीकों का सम्मान तथा उनका संरक्षण करने का दायित्व भी सौंपता है।

विविधता संरक्षण की विधियां-

आज बढ़ते मानवीय क्रियाकलापों जैसे नगरीकरण ,औद्योगीकरण ,खनन ,पर्यटन आदि के कारण जैव विविधता को विश्व के प्रत्येक भाग में बहुत अधिक क्षति पहुंची है जिसके कारण न केवल प्रकृति को नुकसान हुआ है बल्कि मानव जीवन भी दूभर हो गया है अतः समस्त पारितंत्र एवं मानव जाति के स्वस्थ एवं सुरक्षित भविष्य के लिए जैव विविधता का संरक्षण अति आवश्यक है।

अलग-अलग भागों में अलग-अलग उपाय किए गए हैं परंतु जैव विविधता के संरक्षण के लिए निम्नलिखित दो विधियों को विश्व स्तर पर अधिक मान्यता प्रदान की गई है जो इस प्रकार हैं-

1.इन-सीटू कंजर्वेशन (स्वस्थाने संरक्षण)

2. एक्स-सीटू कंजर्वेशन (बाह्य स्थाने संरक्षण)

इन-सीटू कंजर्वेशन-

जब संकटग्रस्त जीव-जंतुओं एवं पादपों को उनके प्राकृतिक आवासो में संरक्षित किया जाता है तो उसे स्वस्थाने संरक्षण कहते हैं। इस विधि में पादप एवं जीव जंतुओं के लिए उपस्थित प्रतिकूल परिस्थितियों का उपचार किया जाता है तथा उनके जीवन के लिए आदर्श एवं अनुकूल स्थिति बनाए रखने का प्रयास किया जाता है। इसके अंतर्गत निम्न का निर्माण किया जाता है-

० बायोस्फीयर रिजर्व

० वन्य जीव अभ्यारण

० राष्ट्रीय उद्यान

० कम्युनिटी रिजर्व

० कंजर्वेशन रिजर्व

० पवित्र झीलें व उपवन

इस विधि के लाभ-

1.यह सबसे प्रचलित और सस्ती विधि है।

2. वातावरण एवं जीव जंतुओं के बीच एक प्राकृतिक सामंजस्य बना रहता है।

3. एक साथ कई प्रजातियों को संरक्षित किया जा सकता है।

4. किसी विशेष तकनीकी की आवश्यकता नहीं होती जैसे कि बाह्यय स्थाने संरक्षण विधि में होती है।

एक्स सीटू कंजर्वेशन-

जब प्राकृतिक आवासों के विखंडन, प्राकृतिक आपदाओं आदि के कारण किसी प्रजाति के लिए अपने प्राकृतिक आवास में ही अस्तित्व का संकट पैदा हो जाता है तो उस प्रजाति को उसके प्राकृतिक आवास से बाहर किसी विशेष स्थान पर संरक्षित किया जाता है तो इस विधि को बाह्य स्थाने संरक्षण कहते हैं। इस विशेष स्थान पर इस प्रजाति के लिए आवश्यक अनुकूल दशाओं का निर्माण किया जाता है ताकि वह वहां जीवित रह सके। इस विधि में निम्न का निर्माण किया जाता है-

० चिड़ियाघर

० जंतु उद्यान

० वनस्पति उद्यान

० वन्य जीव सफारी पार्क

० जीन बैंक

० बीज बैंक

० क्रायोप्रिजर्वेशन

इस विधि के लाभ-

1. इसके द्वारा वनों में विलुप्त प्रजातियों का भी संरक्षण किया जा सकता है।

2. संवेदनशील प्रजातियों का भविष्य के लिए संरक्षण एवं देखभाल।

3. कृषि फसलों का संरक्षण एवं उनकी उत्पादकता में वृद्धि।

4. निम्न तापीय परिरक्षण के द्वारा संकटग्रस्त जातियों के युग्मको को लंबे समय तक परिरक्षित रखा जा सकता है तथा उनका इन-विट्रो फर्टिलाइजेशन भी किया जा सकता है।

अंत निर्विवाद रूप में कहा जा सकता है कि जैव-विविधता मानव सभ्यता के विकास की स्तम्भ है इसलिये इसका संरक्षण अति आवश्यक है। जैव-विविधता हमारे भोजन, कपड़ा, औषधीय, ईंधन आदि की आवश्यकताओं की पूर्ति के साथ-साथ पर्यावरण संरक्षण में भी महत्त्वपूर्ण भूमिका अदा करती है। जैव-विविधता पारिस्थितिक संतुलन को बनाये रखने में सहायक होती है।

Chapter - 15

"अज्ञेय के काव्य में पयावरण चिन्ता"

डा. कल्पना दुबे
एम. एम. ए्ि. का.

भारत में प्राचीन समय से ही जीवन जीने की एक विशेष वैज्ञानिक पद्धति रही है। प्राचीन सभ्यताओं से लेकर वैदिक युग तक विचार करने पर हम पाते हैं कि ये सभ्यताएं बहुत सुनियोजित और व्यवस्थित तरीके से बसी थी । इन्होंने पर्यावरण के अनुकूल निर्माण किया और पर्यावरण के घटकों जैसे जल,जमीन,वायु, वनस्पतियों,आकाश आदि को बहुत महत्व दिया है। इस बात का प्रमाण यह है कि समस्त प्रकृतिक अवयव श्रद्धा भाव से ग्रहण किये गये।ऊषा, अग्नि,वरुण और इन्द्र आदि देवता के रुप में पूजे जाते रहे हैं। ऋषियों ने जीवन में प्रकृति को विशेष महत्व दिया है। जीवन के सम्यक् सन्तुलन के लिए प्रकृति और पर्यावरण के सन्तुलन को जरूरी माना है। पर्यावरण भारतीय चिंतन धारा का विशेष महत्वपूर्ण पक्ष है। वर्तमान समय में यह संकट के दौर से गुजर रहा है। वायु और जल सबसे ज्यादा दूषित हुआ है।अन्य घटकों की स्थिति भी सोचनीय है।इस सबका कारण मनुष्य की स्वेच्छाचारी है। हम अभी भी सचेत नहीं हो रहे हैं। परिणाम हमें ही भोगना होगा । आज पर्यावरण पर गोष्ठी, विभिन्न, सम्मेलन, बहस आदि तमाम चीज़े हो रही हैं। पर्यावरण चिंतन सुरक्षा और समाधान निरंतर बहस का हिस्सा बने हुए हैं। लेकिन जब तक हम सभी जागरूक और जिम्मेदार नहीं होंगे सुधार संभव नहीं होगा।

यह आज का सर्वाधिक चर्चित प्रत्यय है। पर्यावरण से तात्पर्य क्या है? यह हमारे लिए किस प्रकार उपयोगी है? इसे विविध प्रकार से परिभाषित किया गया है। लेकिन सबका सार यही है कि जो कुछ भी हम लोगों को आवृत्त करता है और जीवन को प्रभावित करता है, वह सब कुछ पर्यावरण है----.

" यद् किंचिदपि अस्मान् परिवृणोति जीवन जीवनश्च प्रभावयति तत्सर्वमेव पर्यावरणम् "

वन,वक्षृ , पशु ,पर्वता, नदी, झरने, सरोवर, आकाश, जल, पृथ्वी, वायु, समुद्र, पशु, पक्षी आदि सभी पर्यावरण हैं,या उसके अभिन्न अंग हैं। संक्षेप में हम कह सकते हैं कि प्रकृति ही पर्यावरण है

और पृथ्वी पर पर्यावरण प्रकृति का ही अनमोल उपहार है। वास्तुत: पर्यावरण उन सभी दशाओं, प्रणाली व प्रभावों का योग है जो जीवों और उनकी प्रजातियों के विकास जीवन और मृत्यु को प्रभावित करता है।जल-थल-नभ तीनों में जैविक रूप में उपस्थित अवयव पर्यावरण का ही भाग है। यह जीवन और जगत का बहुत अहम् हिस्सा है। इस बात का ज्ञान हमें प्राचीन ज्ञान परंपरा से होता है।भारतीय चितंन में पर्यावरण संरक्षण की अवधारणा मानव इतिहास जितना ही प्राचीन है। प्रकृति और पर्यावरण के सन्तुलन की अनिवार्यता को हमारे ऋषियो ने जरूरी माना था । उन्होंने प्रकृति की निकटता में प्रकृति के कोमल भैरव रुप को जाना समझा था । प्रकृति हमारी वैदिक ऋचाओ में मौजूद है। इसलिए प्रकृति के सभी क्रियाकलाप वैदिक ऋचाओ में वर्णित हैं। हमारे ऋषियो ने पर्यावरण की महत्ता को बहुत गंभीरता से अनुभव किया था। वैदिक मंत्र इसी बात के द्योतक हैं।यजुर्वेद का का एक मन्त्र है -----

" द्यौ: शान्ति: अंतरिक्षं शान्ति: पृथिवी शान्ति:।

आप: शान्ति: ओषधय: शान्ति वनस्पतय: शान्ति:।।

विश्वदेवा: शान्ति: ब्रह्म शान्ति: सर्वं शान्ति: ।

शान्ति: एव शान्ति: सा मा शान्ति: एधि।।" 1

मेरे लिए द्यु-लोक शांतिप्रद हो, अन्तरिक्ष लोक शांति देने वाला हो, पृथ्वी शान्त-प्रद हो,जल शांति प्रदान करने वाले हों, औषधिया वनस्पतियां शांति दायक हों ब्रह्म शांति -प्रद हों, सब जगह शांति ही शांति हो।

इस वेद मन्त्र में भी पर्यावरण के प्रमुख घटकों और अन्तरिक्ष लोक को सम्यक् सन्तुलन की दशा में रहने की कामना है। हमारे ऋषियो को यह सत्य ज्ञात हुआ कि प्रदुषण पर्यावरण में जीवन की सम्भावना समाप्त हो जायेगी। इस तरह हमारे लिए यह चेतावनी है कि प्रकृति और पर्यावरण के अनुकूल जीवन है और विपरीत जाना या उल्लंघन करना विनाश को न्योता देना है। इसलिए पर्यावरण का सन्तुलन सम्पूर्ण पृथ्वी के लिए महत्वपूर्ण है।

प्राचीन समय में भारत के विभिन्न भूभाग पर बहुत सारे शासकों ने शासन किया है। उन्होंने भी प्रकृति और पर्यावरण के अनुकूल जीवन जीने को महत्व दिया है । उनके प्रबंधन में भी पर्यावरण सुरक्षा का भाव दिखाई देता है। वाटिका, उद्यान, बावडी, कूप, आदि का निर्माण इसी बात का प्रमाण है। पर्यावरण के बिना हम धरती पर जीवन की कल्पना नहीं कर सकते हैं। वास्तव में यह हमारे लिए सुरक्षा कवच है। लेकिन तभी तक जब तक कि यह दूषित, विकृत न हो। इसकी पवित्रता प्रकृति और परिवेष पर निर्भर है और सब कुछ स्वाभाविक, सहज रूप में बना रहे यह तब संभव है जब हमारा अनधिकार प्रयास न हो। इस बात से कुछ लोग भिज्ञ हैं और कुछ अनभिज्ञ हैं परिणामत: आज विश्वभर में पर्यावरण प्रदषूण

से चिंता बढ़ती जा रही है। पर्यावरण की शुदधि और स्वास्थ्य, प्रकृति की शुदधि पर निर्भर करता है और प्रकृति की शुदधि मनुष्य की जागरुकता पर निर्भर है। मनुष्य जनसंख्या में बेतहाशा वृद्धि और प्रकृति संसाधनों का अंधाधुंध दोहन, परमाणु अस्त्रों की संख्या में वृद्धि, उपभोग की संकृति बस दोहन कर रही है।यह स्थिति गंभीर है क्योकि इससे पर्यावरण का अस्तित्व खतरे में है।

हम विकास के नये सोपान निर्मित करते जा रहे हैं। प्राकृतिक संसाधनों का दोहन कर रहे हैं। औद्योगिक विकास से खुश होकर अपनी पीठ थपथपा रहे हैं कि हम किसी से कम नहीं हैं। लेकिन निरंतर बढ़ रहे उद्योगों ने विकार पैदा किया है। ग्लोबल वार्मिंग एक बडा खतरा है।इस वैश्विक गर्मी का परिणाम है कि जीवनदायी ओजोन परत का क्षय हो रहा है। यह रक्षा कवच है।इस "रक्षा कवच " के नष्ट होने से सौर- विकिरण की मार धरती व धरती वासियों को झेलनी पड रही है। पृथ्वी के तापमान में निरंतर वृद्धि हो रही है परिणाम स्वरूप ग्लेशियार का पिघलना और सुकुड़ना जारी है। बहुत सारी नदियां ग्लेशियार पर निर्भर हैं ग्लेशियार से उनका अस्तित्व है वह सूखने की प्रतिकूलता भी झेल सकती हैं।और दूसरा बडा संकट यह भी है कि समुद्र का जलस्तर तर बढ़ भी सकता है।कह सकते हैं कि समूचा प्रकृतिक पर्यावरण असंतुलित हो जायेगा। वैज्ञानिकों की चेतावनी से भय पैदा होने लगा है ।आज जो पर्यावरण पर विचार विमर्श , अध्ययन ,शोध,, विचार गोष्ठी, सेमिनार व सम्मेलन हो रहे हैं। राष्ट्रीय, अंतरराष्ट्रीय स्तर पर कार्य करने वाली संस्थाएं सक्रीय हुई हैं और पर्यावरण सुरक्षा और सुधार के लिए प्रयास किये जा रहे हैं इस बात से भी पर्यावरण के प्रति चिंता का अंदाजा लगाया जा सकता है।

यह सच भी है कि आज पर्यावरण बहुत ख़तरनाक दौर से गुजर रहा है और अब हमारी चिन्ता बढ़ रही है देखा जाए तो हम खुद ही विनाश की पटकथा लिखते आये हैं बस पटाक्षेप बाकी है। हमारी सभ्यता बारुद के ढ़ेर पर बैठी हुई है और हम लोग ही अपने विनाश के लिए उत्तरदायी होंगे। हमसे बहुत अधिक सचेत थे हमारे पूर्वज।

जब हम अपनी सांस्कृतिक विरासत पर द्रष्टि डालते हैं तो पाते हैं कि वो लोग कितनी अच्छी सोच रखते थे। भोग नहीं त्याग में विश्वास करते थे । उनकी शिक्षा आज बहुत प्रासंगिक है। हम पुनः दहुराना चाहते हैं कि ------

"हमारी संस्कृति ने त्याग - पूर्वक भोग की शिक्षा दी थी, "। 2 ,

लेकिन आज यह संदेश बहुत बेमानी हो गया है। बल्कि यह भी कह सकते हैं कि हम बहुत दूर तक सोच नहीं पा रहे हैं। लेकिन हमें यह जरूर याद रखना चाहिये कि मनुष्य के जीवन के अणु,परमाणु प्रकृति के बीज विकसित हुए हैं अतः मनुष्य के साथ प्रकृति और प्रकृति के बीच ही मनुष्य का जीवन सुरक्षित है। यह कोई नई बात नहीं है बल्कि प्रकृति के साथ मनुष्य के सह अस्तित्व की स्वीकृति , पर्यावरण की चिंता तो हमें प्राचीन सभ्यताओं में भी दिखाई देती है।

सिन्धुघाटी सभ्यता में भी पर्यावरण की महत्ता दिखाई देती है। यहां के निवासीयों की प्रकृति के प्रति धर्मिक विश्वासों से यह पता चलता है कि वो प्रकृति और पर्यावरण को बहुत महत्व देते दिखे थे। वृक्षों और वनस्पतियों को पूजते थे। प्रोफेसर डी. एन झा ने लिखा है कि , " उस काल में विभिन्न वृक्षों और जानवरों की भी उपासनाएं होती थी।" 3,

श्रद्धा निवेदन संरक्षण का एक तरीका भी माना जा सकता है। वैदिक सभ्यता में प्रकृति और पर्यावरण के प्रति श्रद्धा भाव प्रकट हुआ है।साथ ही वैदिक चिन्तन पर्यावरण के संबंध में तार्किक और स्पष्ट भी है। ऋषियोंको यह ज्ञात कि शुद्ध वायु, शुद्ध जल, शुद्ध बनौषधिया, अन्न, शुद्ध धरती मानव जीवन के लिए बहुत उपयोगी है--

" आ वात वाहा भैंसें शिवाय वाहा यद्रूप:।

त्वं हि विश्व भेजो देवानांदूत ईयस्ते।। "4-

हमारे ऋषि पर्यावरण के प्रनत चिंतित थे वो न केवल स्तुति करते थे बल्कि पर्यावरण को बनाए रखने के लिए वक्षृ रोपनी की भी बात करते हैं –

" वनस्पतिं वन आस्थापयध्वम् " 5

वनस्पतियां शुद्ध वायु का आधार होंगी समूचा पर्यावरण चक्र इन पर निर्भर है।यह वैज्ञानिक सोच कितनी उपयोगी है।

साहित्यकारों के चिन्तन में भी पर्यावरण हमेशा से रहा है। इनके यहां प्रकृति और पर्यावरण दोनों का अन्योन्याश्रित संबध है।कवियों ने प्रकृति और पर्यावरण का अन्योन्याश्रित संबध मानते हुए पर्यावरण सन्तुलन की बात की है और प्रकृति को विभिन्न रुपों में चित्रित किया है। छायावादी कवियों के यहां प्रकृति को मनुष्य की तरह सुख दुख की अनुभूति से युक्त माना गया है । यहां प्रकृति मानवीय संवेदनाओं से युक्त है वह मनुष्य की तरह ही सुख दुख की अनुभूति करती दिखाई देती है।

हमारी संकृति में प्रकृति को दैवीय रुप दिया गया है। प्रकृति के साहचर्य में रहकर ऋषियों को ज्ञान हुआ कि प्रकृति में सर्वत्र जीवन है।लोक रक्षा हेतु प्रकृति की संरक्षा जरुरी है।वायु,जल, भूमि,वक्षृ, वनस्पतियां आदि जो कि पर्यावरण के घटक तत्व हैं और यही मूलाधार हैं। इनकी महत्ता को वेद पुराण, सभ्यता संकृति,साहित्य आदि हर जगह पर बताया गया है। प्रकृति का हर तत्व लोक में जीवन के लिए जरूरी है। अतः वेदों के समस्त उद्घोष समष्टिगत और लोक कल्याणकारी चिन्तन से जुड़ा दिखाई देता है। पर्यावरण के बिना मनुष्य के जीवत रहने की कल्पना भी कठिन है।यही कारण प्रकृति और पर्यावरण प्राचीन भारतीय चिन्ताधारा के केंद्र में है। वैदिक काल प्रकृति को सन्तुलित रहने की बात करता है। साहित्य में भी प्रकृति और पर्यावरण सन्तुलन को जरूरी माना गया है। साथ ही प्रकृति को मानवीय

भावनाओं से सम्पन्न माना गया है।कहीं प्रकृति लुभाती है, कहीं कवि पर्यावरण संरक्षा के प्रति सजग है तो कहीं प्रकृति, पर्यावरण के साथ मनुष्य के आत्मीय संबंध की बात की गई है। लेकिन हर कहीं प्रकृति और पर्यावरण चर्चा के केंद्र में है।

अज्ञेय पर्यावरण संरक्षा का प्रश्न उठाते हैं। अज्ञेय आधुनिक भारतीय साहित्य के महत्वपूर्ण रचनाकार हैं। इन्होंने प्रकृति,प्रेम और मृत्यु से सम्बंधित कविताएं लिखी हैं। लेकिन प्रकृति पर भी खूब लिखा है।डा. प्रणय कृष्ण ने लिखा है कि -" अज्ञेय की कविताओं का एक बडा भाग प्रकृति ,प्रणय और मृत्यु इन तीन विषयों से संबंध रखता है।" 6, प्रकृति इनका प्रिय विषय है।वह स्वीकार करते हैं कि ' प्रकृति के सानिध्य व साहचर्य से मैं जीवन्त हो उठता हूं।' प्रकृति इनके यहां स्वतंत्र रुप में है। पर्यावरण का मनुष्य के जीवन में महत्व क्या है यह इनकी कविता में देखा जा सकता है। " रुपाबंरा " की भूमिका में प्रकृति पर विचार किया है। अज्ञेय के लिए प्रकृति इतनी महत्वपूर्ण है कि उनके काव्य संग्रह प्रकृति परक हो गये हैं।जैसे 'हरी घास पर क्षण भर', ' महावक्षृ के नीचे ' 'नदी की बांक पर','सदानीरा' आदि। स्वम् भी पेड, पौधे फूल आदि को रोपना सीचना अज्ञेय की रुचि का विषय था। प्रकृति इनके लिए प्रेरणा थी। अज्ञेय की प्रकृति यायावर की थी वह बहुत जगहों पर घूम फीर कर अनुभव संजोए हुए हैं। देश विदेश सब कहीं की प्रकृति की विविधता से परिचित हैं वह प्रकृति की जीवन्ता से मुग्ध होते हैं। इस संबंध में चालीसोत्तर हिन्दी कविता के सम्पादकों की मान्यता है कि " अज्ञेय अनूठे प्रकृति - प्रेमी हैं।वे मानवीय रुप सौन्दर्य के उद्भास के साथ – साथ प्रकृति शोभा का अपूर्व उत्कलन करते हैं। बल्कि कह सकते हैं कि प्रकृति वर्णन में वे हिंदी साहित्य में अद्वितीय हैं। उन्होंने इस भूमण्डल की नानादेशिक धरती को उसकी उदग्र ऊंचाइयों और अथाह गहराइयों के साथ छूने का प्रयास किया है "।7, यह प्रकृति प्रेम ही है कि अपने जीवन के अंतिम दिनों में उन्होंने नीम के पेड (अपने घर के लान में खडे) पर लकडी का एक घर बनवाया था। बच्चों और चिडियों के खेलने के लिए। प्रकृति के सानिध्य में अज्ञेय को जीवन के सौन्दर्य का अहसास होता है -- " प्राकृति दृश्य को देखते हुए मुझे सहसा चेतना की एक लहर आप्लावित कर लेती है कि मैं जीवत हूं, कि जीवन सुन्दर है ,कि जीवत होने की अनुभूति सौन्दर्य की चरम अनुभूति है। " 8,

अज्ञेय के कविता संसार में पर्यावरण के असीमित और अद्वितीय कैनवास में से बहुत सी ऐसी चीजें जिनसे मनुष्य का संबंध है वे पर्यावरणीय संपदा विभिन्न रूपों में सामने आती है।अज्ञेय के लिए प्रकृति और पर्यावरण जीवन की अनुभूति कराने वाली सत्ता है। हमारे चारों ओर पसरा हुआ पर्यावरण जीवन्त,सुन्दर और प्रेरक है इनके बिना मनुष्य के जीवन की कल्पना नहीं की जा सकती है। लेकिन आज की विकट स्थितियों ने ,महत्वाकांक्षा ने, संकट दिया है। खेत,वन, उद्यान खत्म हो रहे हैं।कुंआ, तालाब पाट दिए गए,रोज नये उद्योग, फेक्ट्रिया लगाई जा रही हैं,पेड,पौधे,फूल, वनस्पतियों की जगह उगने लगे हैं कंक्रीट के जंगल। युद्ध आदि की विभीवषका से भी पर्यावरण दूषित हो रहा है। बहुत सारी वनस्पतियां

और जीव जंतु की प्रजाति खत्म हो रही है। ऐसा ही रहा तो हम चिड़ियों का स्वरन भूल जायेंगे , नदियों का कल-कल, छल-छल सुनाई नहीं देगा , मिट्टी की सोंधी सुगन्ध गायब हो जायेगी ,बंजर होने लगेंगे खेत।और बस जड जमा लेंगे कंक्रीट के जंगल,उद्योगों और मशीनों का शोर और सघन उग जायेगी मशीनी सभ्यता। सुन्दर दुनिया विरुप हो जायेगी।मशीनों के साथ हम भी शायद जी लेंगे मशीन बनकर, भावना शून्य से।

साहित्य में यह चिंता खूब देखी जा सकती है। अज्ञेय प्रकृति के साथ निरन्तर किए जा रहे अनाचार से उत्पन्न प्रकृति आपदाओं के संकट से चिजन्तत हैं, व्यग्र है। 1972 में ललखी गई कविता नन्दा में उनकी पर्यावरण चिंता दिखाई देती है।वह पर्यावरण के भविष्य को देख लेते हैं ---

"नन्दा

बीस,तीस पचास वर्षो में

तुम्हारी वनराजीयों की लुगदी बनाकर

हम उस पार

अखबार छाप चुके होंगे

तुम्हारे सन्नाटे को चिथ रहे होंगें,

हमारे धुंधुआते शक्तिमान ट्रक,

तुम्हारे धरने सोते सूख चुके होंगे

और तुम्हारी नदियां

ला सकेंगी केवल शस्य भक्षी बाढ़ें

या आंतों को उमेठने वाली बीमारियां,

तुम्हारा आकाश हो चुका होगा

हमारे अस्तित्व विमानों के घूम सूत्रों का गुंझर।

नन्दा ----

जल्दी ही

बीस तीस पचास बरसों में

हम तुम्हारे नीचे एक मरु बिछा चुके होंगे,

और तुम्हारे उस नदी-धौत सीढ़ी वाले मंदिर में जला करेगा।

एक मरु- द्वीप।" 9,

जब भोग और विकास ही काम्य होगा तो मानवीय मूल्य नहीं बचेंगे।अज्ञेय को पर्यावरणीय विनाश के कारकों की जानकारी है। सबके पीछे उन्होंने भोगवादी संस्कृति को जिम्मेदार माना है। यह सच भी है कि हमारी अनन्त इच्छाओं ने ही प्राकृतिक संसाधनों का दोहन कि या है अतः पर्यावरण असन्तुलन स्वाभाविक है। इन परिस्थितियों से बचने के लिए हमें अपनी सोच को बदलना होगा अत्यधिक भोग की जगह त्याग पूर्ण जीवन को महत्व देना होगा। प्राकृतिक संसाधनों का दोहन नहीं बल्कि संवारना होगा और पर्यावरण की सुरक्षा को बहुत जिम्मेदारी से लेना होगा। तभी सृष्टि को बचाया जा सकेगा।

सन्दर्भ -----

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Chapter - 16

पर्यावरण पर संगीत का प्रभाव

विधुश्री पाण्डेय
शोध छात्रा
इन्दिरा गांधी राष्ट्रीय मुक्त विश्वविद्यालय दिल्ली

"द्यौः शान्तिरन्तरिक्ष ऊं शान्तिः पृथिवी शान्तिरापः शान्तिरोषधयः शान्तिः।वनस्पतयः शान्तिर्विश्वेदेवाः शान्तिर्बहम शान्तिः सर्वं शान्तिः शान्तिरेव शान्तिः सा मां शन्तिरेधि"
१,यजुर्वेद ३६ / १७

द्युलोक, अन्तरिक्ष लोक एवं पृथिवी लोक सुख शांति दायक हो जल औषधि, वनस्पतियां तथा विश्वदेव और ब्रह्म तथा समस्त ब्रह्माण्ड शान्त एवं आनन्दकारी हो ऐसे पुण्यभाव वेद मन्त्रों में ध्वनित हुए हैं।मनुष्य स्रष्टि का सर्वश्रेष्ठ प्राणी है, ईश्वर की सुन्दर रचना है मनुष्य को प्रकृति द्वारा प्राप्त मूल्यवान धरोहर है प्रकृति। प्रकृति के साहचर्य में ही जीवन है यह ज्ञान हमें वेदों के द्वारा, ऋषियों से प्राप्त हुआ।चारों वेद आकाश, पाताल, नदी, सागर, पर्वत, वनस्पति, औषधि, पृथ्वी, नक्षत्र, जीवजंतु, पशु-पक्षी मनुष्य देव सबके मंगल एवं समृद्धि की कामना करते हैं। वेद भारतीय संस्कृति और सभ्यता के मूल स्तंभ हैं। वैदिक समय से जीव-जगत संबंधी चिन्तन दिखाई देता है। और भारतीय मनीषा पर्यावरण को महत्व देती रही है।लोक रक्षा हेतु प्रकृति की संरक्षा जरुरी है। पर्यावरण के घटक तत्व लोक में जीवन शक्ति के लिए जरूरी हैं। मनुष्य के कल्याण की कामना के लिए पर्यावरण उसकी सुरक्षा, प्रकृति के साथ सामीप्य, रोगों के उपचार, स्वास्थ्य संबंधी अनेकों उपाय ऋषियों ने वेद मन्त्रों में उद्घाटित किया है। वेदों ने पर्यावरण चेतना व संरक्षण को लोक से जोड़ा है भूमि सूक्त नामक प्रसिद्ध स्तोत्र वैदिक ऋषियों की पर्यावरण संबंधी चेतना को इंगित करता है। पर्यावरण का सुरक्षित और शान्त होना ही मनुष्य के कल्याण का पर्याय है। वेदों की वाणी समष्टिगत और लोक कल्याणकारी है। अग्नि,वायु, पृथ्वी,जल,आकाश आदि से संबंधित प्रार्थनाएं इसी कल्याण भावना की सूचक हैं।

वैदिक ऋषियों ने पर्यावरण संरक्षण के लिए और प्रदूषण रोकने के लिए जलवायु,वृक्ष और वनस्पतियों को प्रमुख कारण माना है --- " आपो वाता ओषधय:, तान्ये कस्मिन भुवन अर्पितानि"।

पर्यावरण से हमारा अस्तित्व है। ऋषियों ने पांच भौतिक तत्वों की देव रुप में स्तुति की है। अथर्ववेद में कहा गया है कि जहां पर्यावरण परिशुद्ध रहता है वहां मनुष्य पशु पक्षी आदि सभी निरोग एवं सुखपूर्वक जीवन आनंद प्राप्त करते हैं। प्रकृति के तत्व नियम और अनुशासन में काम करते हैं वह मनुष्य को भी अनुशासित रहने की शिक्षा देते हैं।।प्राचीन समय में ऋषियों ने अपने जीवन में प्रकृति के बीच रह कर अनुशासन का पालन किया।यह निरोगी शारीरिक मानसिक स्वास्थ्य से सम्पन्न थे और सौ -सौ वर्ष तक की आयु प्राप्त करते थे।उनका जीवन सात्विक होता था उनका खान-पान विशुद्ध था। उनकी सोच बहुत वैज्ञानिक थी ।वो प्रकृति की सुरक्षा , कम से कम दोहन आवश्यकता को सीमित रखना और पर्यावरण की शुद्धि पर बहुत ध्यान देते थे विषाक्त पदार्थ, गैसें,और वैक्टीरिया आदि से बचने के लिए यज्ञादि किया करते थे।यज्ञ प्रकृति से पर्यावरण शोधन होता रहता है तथा प्रकृति चक्र नियमित एवं सन्तुलित रहता है। अथर्ववेद में कहा गया है कि जल, वायु और औषधियां ये तीन पर्यावरण के संघटक तत्व हैं।साथ ही यह भी कहा गया है कि जहां पर्यावरण परिशुद्ध रहता है वहां मनुष्य पशु -पक्षी आदि सभी निरोग एवं सुखपूर्वक जीवन आनंद प्राप्त करते हैं।पानी हवा और भोजन की शुद्धि स्वस्थ शरीर की पहली सीढ़ी है। प्रकृति से हम और हमसे प्रकृति है इस बात को जरूर ध्यान में रखना चाहिए।हम जितने अधिक प्रकृति को स्वाभाविक,सहज रखेंगे जीवन उतना ही सुरक्षित रहेगा और इसमें पर्यावरण की बहुत बड़ी भूमिका है।यह सचेतनता ऋषियों के चिन्तन में भी होता था ।आज पर्यावरण की सुरक्षा के प्रति जागरूकता देखी जा रही है। मनुष्य की भोगवादी लिप्सा ने पर्यावरण का बहुत नुकसान किया है।यह जानते हुए भी कि पर्यावरण जीवन के लिए बहुत महत्वपूर्ण है यह पारिस्थितिक संतुलन बनाए रखता है यह हमारी सभी जरूरतों को पूरा करता है और अब यह सब कुछ विज्ञान ने भी सिद्ध कर दिया है तब भी जल -जमीन -जंगल- और जन निरन्तर खतरे में हैं। वनों का विलोपन ,वर्षा का कम होना,जल स्रोत सूख जाना और जो हैं भी वो शुद्ध कम हैं यह सब मिलाकर मनुष्य के जीवन को संकटपूर्ण बना रहा है। सबकी सुरक्षा के लिए कवच का मजबूत होना जरुरी है यह कवच है पर्यावरण।इस तरह हम कह सकते हैं कि मनुष्य का पूरा जीवन ही पर्यावरणीय कारकों पर निर्भर करता है।यह पृथ्वी पर विभिन्न जीवन चक्रों को बनाए रखने में भी मदद करता है।यह प्राकृतिक सौंदर्य को बनाए रखने के साथ ही मनुष्य के शारीरिक मानसिक स्वास्थ्य का भी आवश्यक स्रोत है। प्रकृति ने हमें बेहतर तरीके से जीने के लिए सब कुछ दिया है हमें इसे आगे के लिए सम्हाल कर रखना होगा।इसके लिए सबसे पहले हमें अपनी समझ विकसित करनी होगी और सभी को जागरूक करना होगा कि पर्यावरण पारिस्थितिक सन्तुलन को बनाए रखता है हमें इस प्राकृतिक परिवेश को जो पृथ्वी पर जीवन को विकसित पोषित करता है उसकी सही तरह से सुरक्षा करनी होगी। इस प्राकृतिक परिवेश को ही हम पर्यावरण के रूप में जानते हैं। पर्यावरण का निर्माण परि+ आवरण इन दो शब्दों के मेल से है।परि का अर्थ है चारों ओर और आवरण जो हमें चारों ओर से घेरे हुए है।इस तरह पर्यावरण सभी भौतिक, रासायनिक और जैविक कारकों की समष्टिगत इकाई है।जो जीवधारी को प्रभावित करती है।यह पृथ्वी पर जीवन को विकसित,पोषित और समाप्त करने में मदद करता है।इसका

सन्तुलन जीवन जगत की खुशहाली का कारक है और असन्तुलन विनाश को न्योता देना है।हमारे सौरमंडल में पृथ्वी ही एक ऐसा ग्रह है जहां जीवन पाया जाता है और जीवन और जगत के सभी प्राणी ,जीवजंतु, प्राकृतिक वनस्पतियां मौसम जलवायु सभी इसके अन्तर्गत आते हैं। पर्यावरण न केवल जलवायु संतुलन बनाए रखता है बल्कि जीवन के लिए सभी चीजें हवा, पानी, भोजन आदि उपलब्ध कराता है और हम धुंआ, हानिकारक गैसें, और तमाम तरह की गंदगी के साथ ही युद्ध आदि से पैदा होने वाली विकृतियां परोस रहे हैं।अगर मानव सभ्यता के समय पर दृष्टि डालें तो पाते हैं कि

सभ्यता के आरंभ से पर्यावरण की सुरक्षा के प्रति जागरूकता लोगों में मौजूद थी। किन्तु आज आर्थिक विकास की अंधी दौड़ में पर्यावरण बहुत दूषित हो रहा है।जिसके परिणामस्वरूप गंभीर बीमारियां जन्म ले रही हैं। वनस्पतियां, जीवजंतु कीड़े-मकोड़े मर रहे हैं जो कि प्रकृति के सन्तुलन के लिए उपयोगी हैं।यह चिंता का विषय है।आज पर्यावरण की चिंता पर गोष्ठी, सेमिनार, चर्चा परिचर्चा आयोजित की जा रही हैं। सचमुच यह बहुत बड़ा सवाल है।

प्रकृति और पर्यावरण पर संगीत का बहुत प्रभाव पड़ता है।

ऋषियों ने अनुभव किया कि ब्रह्माण्ड में दिव्य नाद निरन्तर गुंजित हो रहा है।उस नाद में सभी स्वर और भाव समाये हुए हैं।नाद में ,संगीत में, प्राणियों के हृदयगत भाव - संवेदित होकर जागृत होते हैं और अन्तर संगीत तरंगित होने लगता है।संगीत प्रकृति की आत्मा है ईश्वर है, अध्यात्म है, करुणा है , निवेदन है, प्रेम है, वात्सल्य और माधुर्य और सभी भाव हैं।यह प्रकृति के कण-कण में व्याप्त है यह आत्मा का आनंद है। मानव समाज की एक सहज कलात्मक उपलब्धि है संगीत। मानव संस्कृति और सामाजिक परिवेश का अभिन्न अंग भी है।जब हृदय में भावनाओं का उद्वेलन होता है तब संगीत का उद्गम स्वत: होता है। मनुष्य के हृदयगत भावनाओं का सम्बन्ध देश-काल और परिवेश पर भी बहुत कुछ निर्भर करता है।इसी लिए संगीत भी कोमल और भैरव दोनों राग की सृष्टि करता है। प्रकृति और पर्यावरण पर जब भी प्रतिकूल प्रभाव पड़ता है जीवन राग बेसुरा होने लगता है।मनुष्य का जीवन संकटपूर्ण हो जाता है।

संगीत और प्रकृति के मिलन से पर्यावरण को बचाया जा सकता है । संगीत का पर्यावरण के साथ गहरा संबंध है।इसकी उत्पत्ति में भी प्रकृति और पर्यावरण का गहरा नाता है। भरत मुनि ने नाट्यशास्त्र नामक अपनी पुस्तक में स्वरों की उत्पत्ति को पशु पक्षियों से माना है।उनके अनुसार मयूर " सा " (षड्ज) स्वर में,चातक 'रे' (ऋषभ)बकरा 'ग' (गंधार) कोई 'म' (मध्यम), कोयल ' प ' (पंचम) मेंढ़क ' ध ' (देवता) तथा हाथी ' नि' (निषाद) स्वर में बोलते हैं।'3

और मनुष्य की कला से प्रकृति भी प्रभावित होती है। स्वरों की शक्ति और साधक की साधना प्रकृति में संवेदना का संचार कर देती है।कहा जाता है कि अकबर के दरबार में एक गायक हुआ करते थे

तानसेन वह जब अपनी कला का प्रदर्शन करते थे तब आसपास के वातावरण पर जबरदस्त प्रभाव पड़ता था पेड़ पौधे पशु पक्षी झूमने लगते थे।जब वह राग मल्हार गाते थे तब बादल झूम कर बरसते थे।यह संगीत की ताकत थी और पर्यावरण की सब चीजों से प्रभावित होने की ग्रहण शीलता।इसे हम पर्यावरणीय चेतना कह सकते हैं।यह चेतना अच्छे और बुरे दोनों से ही प्रभावित होगी। अगर संगीत की सहज सच्ची साधना से दीपक जल उठते हैं और वर्षा बूंद झरने लगती है तो प्रकृति में बुरा को ग्रहण करने की भी उतनी ही ताकत होगी। इसलिए यह कहा जा सकता है कि संगीत और प्रकृति दोनों जीवन के महत्वपूर्ण अंग हैं। दोनों ही मनुष्य के जीवन और चेतना से प्रभावित होते भी हैं और प्रभावित करते भी हैं। संगीत से जहां प्रकृति को प्रभावित होते हुए देखा है वहीं इससे रोगों से मुक्ति पाते भी सुना है।आज नित्य प्रति नये शोध हो रहे हैं औषधियों वनस्पतियों को संगीत हूं प्रभावित होते हुए सुना है। तनाव ग्रस्त रोगियों को संगीत सुनने की सलाह डाक्टर दिया करते हैं। इस तरह बहुत उपयोगी और शक्ति भी कह सकते हैं संगीत को ,जो पर्यावरण की सुरक्षा भी करता है और पर्यावरण प्राणियों की सुरक्षा का सजग प्रहरी है। कहा जा सकता है कि संगीत और पर्यावरण का अटूट संबंध है तथा ये हमसे और हम इनसे जुड़े हुए हैं। इस बात को सिद्ध किया है प्रोफेसर रिंकी केज ने उन्होंने " म्यूजिक फार प्लेनेट" कार्यक्रम में कहा कि संगीत और प्रकृति दोनों जीवन में पर्यावरणीय चेतना जगाने का कार्य करती हैं। संगीत सिर्फ एक संदेश संचार करने का जरिया ही नहीं बल्कि एक श्रोता की चेतना में गहराई तक किसी भी संदेश को बनाए रखने के लिए शक्तिशाली हथियार है। संगीत और प्रकृति के मिलन से पर्यावरण को बचाया जा सकता है।"2, इस बात पर हमें जरूर गौर करना चाहिए।

संगीत प्रत्येक जीवधारी के मस्तिष्क और नाड़ी संस्थान पर प्रभाव डालता है। नित्य प्रति होने वाले प्रयोग से भी अब सिद्ध हो रहा है कि संगीत पेड़ -पौधे, वनस्पतियां, जीवजंतु सभी को प्रभावित करती हैं।एक पशु वैज्ञानिक डा. जार्ज के वित्स ने छोटे जीव-जंतुओं की शारीरिक मानसिक स्थिति पर पड़ने वाले प्रभाव का अध्ययन भी किया है।उनका कहना है कि घर में बजने वाले पियानो की आवाज सुनकर चूहों को अपने बिल में शान्ति पूर्वक पड़े हुए उन्होंने देखा है।जल-थल-नभ सब कहीं स्वर लहरियों का प्रभाव पड़ता है।

संगीत के माध्यम से इलेक्ट्रो मैग्नेटिक लहरें उत्पन्न होती हैं जो स्नायु तंत्र पर पर प्रभाव डालकर सक्रियता को बढ़ाती हैं और विकृत चिन्तन को रोकती हैं।स्वरों में बहुत ताकत है उनसे शब्द चालित बम और रोबोट तैयार हो रहे हैं।यही नहीं इनसे प्रदूषण निवारण , मनोविकार नमन,शरीर रोग निवारण में तरंगों का प्रयोग किया जा रहा है।प्रजनन शक्ति (पशुओं की) बढ़ानें, पौधों के बढ़ने की गति को अधिक बढ़ाने की तथा अधिक फल उगाने की ताकत संगीत में है।यह शोध के द्वारा वैज्ञानिकों ने सिद्ध किया है।यही नहीं स्वर वैज्ञानिक गायत्री मंत्र के उच्चारण में भी असीम ताकत होने का दावा करते हैं। वैज्ञानिक कहते हैं कि - " ऊं भूर्भुव स्व: तत्सवितुर्वरेण्यं भर्गो देवस्य धीमहि धियो यो न: प्रचोदयात् "

इस मंत्र के समवेत स्वरित जप से उत्पन्न पराध्वनिक में सारे वातावरण को कंपा देने की सामर्थ्य है। इसी लिए हमारे पूर्वजों ने प्रकृति को पूजा भाव से ग्रहण किया था।हम सब भूल रहे हैं धरती आकाश को मलिन कर रहे हैं। प्रभावित हुआ है पर्यावरण और आपदाओं की आहट सुनाई देने लगी है।यह इस बात को सिद्ध करता है कि अच्छा या बुरा हम जैसा भी प्रकृति और पर्यावरण को दे रहे हैं वो भी हमें वही वापस लौटाएंगे।हम सब प्रकार तरक्की उन्नति कर रहे हैं विकास के नारे लगा रहे हैं प्रकृति और पर्यावरण की सुरक्षा भी हमारी है यह चेतना भी जरूरी है।

निष्कर्ष रुप में हम कह सकते हैं कि जिस पंचतत्व - अग्नि,वायु,जल,पृथ्वी और आकाश से मनुष्य के शरीर का निर्माण हुआ है विद्वानों ने इन्हीं पांच तत्वों से स्वरों की उत्पत्ति मानी है। विद्वानों ने माना है कि सा स्वर पृथ्वी, ,रे, ग, जल तत्व , म, पर - अग्नि तत्व ,ध, वायु तथा नि, आकाश तत्व के प्रतिनिधि हैं।यह संगीत और पर्यावरण के आपसी सम्बन्ध के उदाहरण हैं। संगीत और पर्यावरण के बीच के गहरे रिश्ते सभी को ज्ञात हैं। संगीत जड़ और चेतन में व्याप्त हैं। नदियों का कल-कल छल-छल , पक्षियों की चहक और वृक्षों की सरसराहट सब कहीं मधुर संगीत है ।यही जीवन संगीत है।यह हमारी धरोहर है।इसे सम्हाल कर रखना हमारी बहुत बड़ी जिम्मेदारी है।यह कहना अतिश्योक्ति नहीं होगी कि पर्यावरण स्वस्थ है तो हम हैं हम हैं तो संसार है।

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Chapter - 17

21 वीं शताब्दी में हमें विकास नहीं अपितु संपोषणीय विकास की आवश्यकता

गजेन्द्र सिंह राठौड़[1], डॉ. सुनील कुमार[2]

[1]शोधार्थी (भूगोल विभाग)

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हम जानते हैं कि हमें निरंतर पर्यावरण से संबंधित अनेक प्रकार की समस्याओं जैसे प्रदूषण, संसाधनों का बड़ी मात्रा में विनाश, ग्लोबल वॉर्मिंग आदि का सामना करना पड़ रहा है इसका मुख्य कारण आर्थिक विकास की अंधाधुंध दौड़ हैं, जिसमें बिना सोचे–समझे विकास व धन के लालच में अनमोल प्राकृतिक संसाधनों को लगातार नष्ट किया जा रहा है। यदि हमें इस नुकसान से बचना है है तो हमें सतत विकास के द्वारा नवीकरणीय तथा अनवीकरणीय संसाधनों को ध्यान में रखकर विकास की इस गाड़ी को निरंतर आगे बढ़ाना होगा। 2015 में सहस्राब्दी विकास लक्ष्य समाप्त होने के कारण इसके स्थान पर 17 सतत विकास को प्राप्त करने का फैसला किया गया जो संयुक्त राष्ट्र शिखर सम्मेलन में लिया गया था। इससे संबंधित बैठक 25 से 27 सितंबर 2015 में हुई इसमें 2016 से 2030 तक 17 लक्ष्य सुनिश्चित किए गए, इसमें 193 देश सम्मिलित हुए थे। स्थायी विकास की अवधारणा, हालांकि 1970 के दशक में दिखाई दी थी, 1980 के दशक में विश्व संरक्षण रणनीति (IUCN, UNE'P और WWF, 1980) द्वारा व्यापक

रूप से प्रचारित किया गया था, जो आवश्यक पारिस्थितिक प्रक्रियाओं के रख–रखाव के लिए कहा जाता था; जैव विविधता का संरक्षण; और प्रजातियों और पारिस्थितिक तंत्र का स्थायी उपयोग।

ब्रुंडलैंड रिपोर्ट रिपोर्ट, हमारे सामान्य भविष्य (पर्यावरण और विकास पर विश्व आयोग, 1987) ने इसे दुनिया के राजनीतिक एजेंडे पर रखा और पर्यावरण में सार्वजनिक हित को फिर से बनाने में मदद की। इसने यह संदेश भी फैलाया कि वैश्विक पर्यावरण प्रबंधन की आवश्यकता थी; और यह कि गरीबी में कमी के बिना, पारिस्थितिकी तंत्र की क्षति का मुकाबला करना मुश्किल होगा। ब्वदे वर्ल्ड कंजर्वेशन स्ट्रैटेजी 'के बीस साल बाद उन्हीं तीन निकायों ने दी कैरिंग फॉर द अर्थ' (IUCN, UNEP और WWF, 1991) प्रकाशित किया, जिसमें सिद्धांतों को अभ्यास से आगे बढ़ने में मदद करने के लिए प्रस्तावित सिद्धांत थे।

सतत विकास की अवधारणा को 1980 के दशक की शुरुआत में (विशेष रूप से IUCN, UNEP और WWF, 1980 द्वारा विश्व संरक्षण रणनीति के प्रकाशन के माध्यम से) संरक्षण और विकास के उद्देश्यों को समेटने के लिए पेश किया गया था। इसके बाद से इसने बहुत चर्चा बटोरी।

सतत विकास का अर्थ सतत विकास को धारणीय या टिकाऊ विकास भी कहते हैं "सतत विकास, विकास की वह प्रक्रिया है जिसके द्वारा पर्यावरण तथा प्राकृतिक संसाधनों को नुकसान पहुंचाए बगैर वर्तमान पीढ़ी तथा भावी पीढ़ी (आने वाली पीढ़ी) के जीवन की गुणवत्ता में सुधार करना है""सतत या टिकाऊ विकास, विकास की वह प्रक्रिया है जिसके द्वारा वर्तमान व भावी पीढ़ी की आवश्यकताओं से समझौता किए बिना पर्यावरण तथा प्रकृति की सुरक्षा को ध्यान में रखकर आर्थिक विकास किया जा सके। "आज के समय में हम जिस प्रकार का विकास देख रहे इस प्रकार का विकास हमारी प्रकृति तथा वर्तमान पीढ़ी तथा भावी पीढ़ी के लिए खतरनाक है जिसमें हम अनवीकरणीय प्राकृतिक संसाधनों का बड़ी मात्रा में विनाश कर रहे हैं।

Sustainable Development के लक्ष्यों को पहली बार 2015 में संयुक्त राष्ट्र के सदस्य राज्यों द्वारा अपनाया गया था। संपोषणीय विकास अवधारणा का उद्देश्य प्रोडक्ट्स और सेवाओं के उपयोग को इस तरह से प्रोत्साहित करना है जो पर्यावरण पर प्रभाव को कम करता है और मानव को संतुष्ट करने के लिए संसाधनों का अनुकूलन करता है। जरूरत है। यह समझने के लिए कि संपोषणीय विकास समय की आवश्यकता क्यों है, निम्नलिखित प्रमुख बिंदुओं पर एक नज़र डालें जो इसके महत्व को स्पष्ट करते हैं–

- गैर–प्रदूषणकारी नवीकरणीय ऊर्जा प्रणालियों का विकास
- जनसंख्या स्थिरीकरण • एकीकृत भूमि उपयोग योजना
- स्वस्थ फसल भूमि और घास का मैदान

- वुडलैंड और सीमांत भूमि का पुनरू वनस्पति
- जैविक विविधता का संरक्षण
- जल और वायु में प्रदूषण का नियंत्रण
- कचरे और अवशेषों का पुनर्चक्रण
- पारिस्थितिक रूप से अनुकूल मानव बस्तियाँ

संपोषणीय विकास का महत्व

हम जिस पर्यावरण में रहते हैं उसके लिए जिम्मेदार होने के महत्व को ध्यान में रखते हुए संपोषणीय विकास की दिशा में काम कर रहा है। संपोषणीय विकास का मूल विचार कल की जरूरतों को ध्यान में रखते हुए आज के लिए काम करना है। संपोषणीय विकास का महत्व यह है कि यह आने वाली पीढ़ियों की जरूरतों से समझौता किए बिना वर्तमान पीढ़ियों की जरूरतों को पूरा करता है। संपोषणीय विकास हमें अपने संसाधनों का सही तरीके से उपयोग करना सिखाता है। नीचे सूचीबद्ध कुछ बिंदु हैं जो हमें संपोषणीय विकास के महत्व को बताते हैं–

• सतत कृषि विधियों पर ध्यानदृ संपोषणीय विकास महत्वपूर्ण है क्योंकि यह आने वाली पीढ़ियों की जरूरतों का ख्याल रखता है और यह सुनिश्चित करता है कि बढ़ती आबादी धरती माता पर बोझ न डालें। यह ''षि तकनीकों को बढ़ावा देता है जैसे फसल चक्रण और प्रभावी बीज बोने की तकनीक।

• जलवायु को स्थिर करने का प्रबंधन करता है दृ हम जीवाश्म ईंधन के अत्यधिक उपयोग और जानवरों के प्रा''तिक आवास को मारने के कारण जलवायु परिवर्तन की समस्या का सामना कर रहे हैं। संपोषणीय विकास, टिकाऊ विकास प्रथाओं द्वारा जलवायु परिवर्तन को रोकने में एक प्रमुख भूमिका निभाता है। यह जीवाश्म ईंधन के उपयोग को कम करने को बढ़ावा देता है जो वातावरण को नष्ट करने वाली ग्रीनहाउस गैसों को छोड़ते हैं।

• महत्वपूर्ण मानवीय आवश्यकताएं प्रदान करता है– संपोषणीय विकास भविष्य की पीढ़ियों के लिए बचत के विचार को बढ़ावा देता है और यह सुनिश्चित करता है कि संसाधन सभी को आवंटित किए जाएं। यह एक ऐसे बुनियादी ढांचे को विकसित करने के सिद्धांत पर आधारित है जिसे लंबे समय तक कायम रखा जा सकता है।

• सतत जैव विविधता– यदि संपोषणीय विकास की प्रक्रिया का पालन किया जाता है, तो अन्य सभी जीवित जानवरों के घर और आवास समाप्त नहीं होंगे। चूंकि संपोषणीय

विकास पारिस्थितिकी तंत्र को संरक्षित करने पर केंद्रित है, यह जैव विविधता को बनाए रखने और संरक्षित करने में स्वचालित रूप से मदद करता है।

• वित्तीय स्थिरता– जैसा कि संपोषणीय विकास स्थिर विकास का वादा करता है, जीवाश्म ईंधन के उपयोग की तुलना में ऊर्जा के नवीकरणीय स्रोतों का उपयोग करके देशों की अर्थव्यवस्थाएं मजबूत हो सकती हैं, जिनमें से हमारे ग्रह पर केवल एक विशेष राशि ळें

संपोषणीय विकास के तीन स्तंभ

Sustainable Development Meaning in Hindi का कांसेप्ट तीन मुख्य स्तंभों में निहित है जिसका उद्देश्य समावेशी विकास प्राप्त करना और साथ ही वर्तमान पीढ़ी के लिए साझा समृद्धि बनाना और भविष्य की पीढ़ियों की जरूरतों को पूरा करना जारी रखना है। ये तीन स्तंभ आर्थिक, सामाजिक और पर्यावरण विकास हैं और आपस में जुड़े हुए हैं और सामुदायिक विकास और सामाजिक और पर्यावरणीय स्थिरता के लक्ष्यों को दर्शाते हैं। आइए इन स्थायी विकास के स्तंभों को और विस्तार से देखें–

आर्थिक स्थिरता

आर्थिक स्थिरता उन गतिविधियों को बढ़ावा देने का प्रयास करती है जिनके माध्यम से समुदाय के पर्यावरणीय, सामाजिक और सांस्‍कृतिक पहलुओं पर नेगेटिव प्रभाव डाले बिना लॉन्ग–टर्म आर्थिक विकास प्राप्त किया जा सकता है। संपोषणीय विकास का कांसेप्ट के लिए एक प्रमुख सूत्रधार के रूप में, आर्थिक स्थिरता के बुनियादी मूल तत्व इस प्रकार हैंरू

• पर्यावरणीय दृष्टि से विश्व में भूख और गरीबी के लिए प्रभावी समाधान खोजना।

• अर्थशास्त्र इस बात का अध्ययन है कि समाज अपने संसाधनों (पानी, वायु, भोजन, ईंधन, आदि) का उपयोग कैसे करता है और जब इसे स्टेनेबल डेवलपमेंट के कांसेप्ट के साथ जोड़ा जाता है, तो यह आर्थिक विकास प्राप्त करने पर केंद्रित होता है जो केवल टिकाऊ होता है और साथ ही साथ हमारे जीवन की गुणवत्ता में सुधार करता है।

• आर्थिक स्थिरता को तीन सामान्य श्रेणियों में बांटा गया है ताकि स्टेनेबल डेवलपमेंट, यानी मूल्य और मूल्यांकन, नीतिगत साधन और गरीबी और पर्यावरण शामिल हो।

सामाजिक स्थिरता

सामाजिक स्थिरता सामाजिक जिम्मेदारी का एक रूप है जो महत्वपूर्ण रूप से तब होता है जब किसी समुदाय के स्थिर और अस्थिर फैक्टर्स को समाप्त संसाधनों के रेस्टोरेशन की आवश्यकता होती है। यह सामाजिक वातावरण के साथ भौतिक पर्यावरण

के डिजाइन को जोड़ती है और एक समुदाय में विभिन्न वर्गों की जरूरतों पर ध्यान केंद्रित करती है और कमजोर वर्ग को सही बुनियादी ढांचा और आवश्यक सहायता प्रदान करने पर विशेष जोर देती है। यह संपोषणीय विकास के कांसेप्ट को समझने में शामिल एक अन्य पैरामीटर है और सामाजिक स्थिरता के प्रमुख बुनियादी सिद्धांत हैं–

- व्यवस्थित सामुदायिक भागीदारी
- सरकार सहित मजबूत नागरिक समाज
- ईमानदारी के आम तौर पर स्वीकृत मानक (सहिष्णुता, करुणा, सहनशीलता, प्रेम)
- लैंगिक समानता

सांस्कृतिक स्थिरता

संस्कृति संपोषणीय विकास के कांसेप्ट के मुख्य घटकों में से एक है। सांस्कृतिक अधिकारों के महत्व और सांस्कृतिक विरासत के संरक्षण के बारे में बढ़ती जागरूकता से सांस्कृतिक स्थिरता की आवश्यकता उत्पन्न होती है। कुछ प्रमुख कारक जिन पर सांस्कृतिक स्थिरता आधारित है, वे हैं–

- **सुसंस्कृत व्यक्ति :** मन की एक विकसित स्थिति के परिणामस्वरूप समुदायों के बीच जागरूकता बढ़ सकती है जो सार्वभौमिक मानव अधिकारों के लिए महत्वपूर्ण सांस्कृतिक विविधता की रक्षा और बढ़ावा देगी।

- **वैश्वीकरण :** विभिन्न देशों में फैली विविध संस्कृतियों के साथ, बहुसांस्कृतिक राष्ट्रों के उदय के साथ–साथ उनके सामने आने वाले विभिन्न मुद्दों को संबोधित करने के लिए वैश्वीकरण के प्रभावों पर अनिवार्य रूप से चर्चा करने की आवश्यकता है।

सतत विकास की आवश्यकता क्यों है ?

- प्रदूषण में वृद्धि ना हो– सतत विकास की आवश्यकता इसलिए है क्योंकि प्रदूषण में वृद्धि ना हो क्योंकि धारणीय विकास उन कार्य को अनुमति नहीं देता जिनके द्वारा वर्तमान जीवन की आवश्यकता व उत्पादन के लिए प्र" ति तथा पर्यावरण को नुकसान पहुंचे।
- भावी पीढ़ी की आवश्यकता तथा विकास में कमी ना हो– सतत विकास इस बात का समर्थन करता है कि वर्तमान में विकास या आवश्यकता को पूरा करने के लिए हमें भावी पीढ़ी की आवश्यकताओं को भी ध्यान में रखना होगा तथा अनवीकरणीय संसाधनों का इस्तेमाल सोच– समझकर करना होगा जिससे आने वाली पीढ़ी को संसाधनों की कमी महसूस ना हो।
- प्रकृति की सुरक्षा हेतु– सतत विकास का मतलब यह नहीं है कि हमें प्राकृतिक संसाधनों का इस्तेमाल ही नहीं करना, बल्कि हमें प्राकृतिक संसाधनों को सोच

समझकर इस्तेमाल करना है जिससे हमारी प्रकृति की उपयोगिता तथा गुणवत्ता में कमी ना हो तथा आने वाली पीढ़ी के लिए किसी भी प्रकार का अवरोध या खतरा उत्पन्न ना हो।

- आर्थिक व सामाजिक विकास– सतत विकास इसलिए भी महत्वपूर्ण है कि इसके द्वारा आर्थिक व सामाजिक विकास सही ढंग से किया जा सकता है क्योंकि जिस प्रकार जनसंख्या निरंतर तेजी से बढ़ रही है जिसके कारण भविष्य में भोजन, पानी, ऊर्जा तथा संसाधनों की मांग तेजी से बढ़ेगी,जिसके कारण हमें भयंकर दुष्परिणामों का सामना करना पड़ सकता है।
- ग्लोबल वॉर्मिंग– निरंतर औद्योगिकरण के कारण ग्लोबल वार्निंग यानी पृथ्वी का तापमान निरंतर बढ़ रहा है जिसके कारण प्रकृति पर अविश्वसनीय प्रभाव पड़ता है क्योंकि प्रकृति के इस विनाश में अनेक प्रकार की खतरनाक ग्रीन हाउस गैसें– CO_2, नाइट्रस ऑक्साइड, मिथेन, क्लोरोफ्लोरोकार्बन आदि के घातक प्रभाव शामिल होते हैं परंतु सतत विकास हमें उन कार्यों की अनुमति नहीं देता जिनके कारण प्रकृति को इस प्रकार के घातक परिणाम झेलने पड़े।
- महामारियों पर रोक– जैसे हम जानते हैं कि हमारे देश में पहले भी अनेक प्रकार की महामारिया आई हैं जैसे 1918 में इनफ्लुएंजा (फ्लू) इसके कारण विश्व में लगभग 5 से 10 करोड़ लोगों की जान गई ऐसा इसलिए हुआ क्योंकि उस समय स्वास्थ्य सुविधाएं अधिक नहीं थी तथा लोग कुपोषण के शिकार भी थे। इसी के साथ हम आज भी कोविड–19 जैसी महामारी को झेल रहे हैं यही कारण है कि हमें सतत विकास की आवश्यकता है क्योंकि इसके द्वारा हम महामारियों का पूर्ण रूप से निवारण कर पाएंगे।

  सतत विकास हेतु निर्धारित लक्ष्य– इन लक्ष्यों में गरीबी, प्रदूषण, शांति, न्याय आदि अनेक शामिल है जिनके द्वारा मानव जीवन का निरंतर विकास होता रहे तथा वर्तमान पीढ़ी तथा भावी पीढ़ी के जीवन में सुख–शांति तथा विकास निरंतर बना रहे।
- समाज में न्याय व शांति– सतत विकास का समाज में न्याय व शांति स्थापित करना एक महत्वपूर्ण लक्ष्य है जिसका उद्देश्य समाज में न्याय तथा शांति स्थापित कर न्याय तक पहुंच सुनिश्चित करना है।
- गरीबी को समाप्त करना– टिकाऊ विकास का एक महत्वपूर्ण लक्ष्य गरीबी को पूर्णतः समाप्त कर एक शांतिपूर्ण व सभ्य समाज की स्थापना करना है। अभी गरीब उन लोगों को माना जाता है जो लगभग 96 रु. में प्रतिदिन अपना गुजारा करते हैं।
- भुखमरी (अकाल) को पूर्णता समाप्त करनादृ धारणीय विकास के इस लक्ष्य में भुखमरी को पूरी तरह से समाप्त कर टिकाऊ ‘‘षि, खाद्य सुरक्षा तथा बेहतर पोषण को प्राथमिकता दी जाएगी।

- लक्ष्य प्राप्ति के लिए सामूहिक साझेदारी २ सतत विकास के इस लक्ष्य में वैश्विक भागीदारी को पुनर्जीवित करने के साथ–साथ किसी निश्चय को कार्य रूप में बदलने वाले साधनों को मजबूत बनाना है।
- भूमि संरक्षण– टिकाऊ विकास का एक महत्वपूर्ण लक्ष्य भूमि संरक्षण (भूमि पर जीवन) है टिकाऊ विकास को बढ़ावा देने वाले स्थलीय पारिस्थितिकी प्रणाली, मृदा अपरदन, सुरक्षित जंगलों तथा जैव विविधता के बढ़ते नुकसान को रोकना है।
- जल संरक्षण– इस लक्ष्य में टिकाऊ विकास के लिए समुद्र व समुद्री संसाधनों, महासागरों तथा जल के अन्य स्रोतों का संरक्षण करना है।
- जलवायु परिवर्तन– धारणीय विकास का एक मुख्य लक्ष्य जलवायु परिवर्तन के कारण होने वाले नुकसान या प्रभावों से बचने के लिए तत्काल कार्रवाई सुनिश्चित कर इससे संबंधित संसाधनों का विकास विकास करना ळें
- उपभोग व उत्पादन प्रणाली को सशक्त बनाना– इस लक्ष्य के द्वारा उपभोग व उत्पादन प्रणाली को मजबूत और टिकाऊ बनाना है।
- सामुदायिक तथा शहरी विकास– इस लक्ष्य के द्वारा शहरों व मानव बस्तियों को सुरक्षित, लचीला, मजबूत व शांतिपूर्ण बनाना है।
- असमानता में कमी– इस विकास प्रणाली का मुख्य लक्ष्य देश की अर्थव्यवस्था में वृद्धि कर देश के भीतर व देशों के बीच असमानता को कम करना है।
- उद्योग व बुनियादी ढांचे का विकास– इस लक्ष्य के द्वारा सशक्त मूलभूत ढांचा बनाना तथा टिकाऊ औद्योगीकरण को बढ़ावा देना।
- अच्छा रोजगार व आर्थिक विकास– इसका मुख्य उद्देश्य सभी के लिए अच्छा रोजगार उपलब्ध कराने के साथ–साथ टिकाऊ आर्थिक विकास व उत्पादक रोजगार को प्रोत्साहित करना है।
- सस्ती और स्वच्छ ऊर्जा– इसका मुख्य उद्देश्य सभी के लिए सस्ती, स्वच्छ व भरोसेमंद ऊर्जा तक पहुंच सुनिश्चित करना जो पर्यावरण के अनुकूल भी हो।
- स्वच्छ पानी तथा स्वच्छता को प्रोत्साहन– इसके द्वारा सभी के लिए स्वच्छ पानी उपलब्ध कराकर, स्वच्छ पानी व स्वच्छता की प्रणाली को सशक्त बनाना है।
- लैगिक समानता (Gender equality)– इसके द्वारा लैंगिक समानता प्राप्त करने के साथ–साथ महिलाओं और लड़कियों को हर क्षेत्र में विकास के लिए प्रोत्साहित करना।
- अच्छी शिक्षा– इस लक्ष्य के द्वारा सभी के लिए अच्छी शिक्षा तथा पहुंच सुनिश्चित कर गुणवत्तापूर्ण शिक्षा को बढ़ावा देना जिससे सभी को अच्छा रोजगार मिले तथा बेरोजगारी जैसी समस्याओं को दूर किया जा सके।
- अच्छा स्वास्थ्य– इसके द्वारा स्वास्थ्य सुविधाओं का विकास कर,स्वास्थ्य तथा जीवन स्तर में सुधार करना है।

सतत विकास की प्राप्ति के लिए कुछ आवश्यक कदम

- साधन दक्ष तकनीकदृ साधन दक्ष तकनीक सतत विकास को प्राप्त करने के लिए अति आवश्यक है क्योंकि उभरती हुई आवश्यकता का सामना करने के लिए हमें ऐसी उत्पादन तकनीक खोजनी होगी जिससे कम (इकाई) साधन के इस्तेमाल से अधिक उत्पादन हो।
- पर्यावरण मित्र ऊर्जा का इस्तेमालदृ पर्यावरण के अनुकूल ऊर्जा स्त्रोतों का इस्तेमाल धारणीय विकास के लिए अति आवश्यक है पेट्रोल व डीजल के स्थान पर एल.पी.जी व सी.एन.जी का इस्तेमाल किया जाना चाहिए क्योंकि पेट्रोल–डीजल के कारण पर्यावरण को दूषित करने वाली गैस अत्यधिक मात्रा में उत्पन्न होती है।
- सूर्य किरणों को सौर ऊर्जा व विद्युत ऊर्जा में बदलनादृ जैसा कि हम जानते हैं कि उत्पादन के लिए ऊर्जा अति आवश्यक है परंतु जीवाश्म ईंधन का प्रयोग अनवीकरणीय ऊर्जा स्रोतों को कम करता है कोयले, पेट्रोल आदि का प्रयोग CO_2 के उत्सर्जन को बढ़ाता है जिसके कारण प्रदूषण होता है।
- इसके विपरीत सूर्य किरण पर्यावरण मित्र व कभी न समाप्त होने वाला प्रा"तिक संसाधन है जिसे सौर ऊर्जा व विद्युत ऊर्जा में परिवर्तन कर धारणीय विकास को प्राप्त कर सकते हैं।
- जैविक खेती को बढ़ावादृ रसायनिक खाद तथा कीटनाशक आदि का इस्तेमाल फसल उत्पादन में वृद्धि करता है लेकिन यह मृदा की उपजाऊ क्षमता पर ही निर्भर है जिसका अर्थ है भविष्य में मृदा की उत्पादन क्षमता में कमी आएगी इसलिए हमें भावी पीढ़ी की आवश्यकताओं को देखते हुए जैविक खेती को अधिक प्राथमिकता देनी होगी।
- अपशिष्ट पदार्थों का पुनर्चक्रणदृ घरेलू औद्योगिक अपशिष्ट पदार्थों को इधर–उधर फेंकने के कारण पर्यावरण प्रदूषण में वृद्धि होती है हमें ऐसा ना करके उनका पुनर्चक्रण यानी किसी भी प्रकार से दोबारा इस्तेमाल करने का प्रयत्न करना चाहिए जैसे घरेलू घरेलू अपशिष्ट, का खाद के रूप में जैविक खेती के लिए इस्तेमाल।
- रसायनिक अपशिष्ट के निपटान पर कड़े कानूनदृ भारत जैसे देश में कानून तो बनाए जाते हैं परंतु उनका पालन २ढ़ता के साथ नहीं किया जाता औद्योगिक रासायनिक अपशिष्ट हमारी नदियों, तालाबों, झरनो आदि को दूषित करते हैं।
- जो जलीय जीव व स्वच्छ पानी का विनाश करता है हमें इस प्रकार के नुकसान से बचने के लिए इससे संबंधित कानून बनाकर उनका कठोरता से पालन करना चाहिए।

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Editorial Office : UG-4, Avadh Tower, Naval Kishore Road, Opp. Kaysons Lane, Hazratganj, Lucknow-226001, Uttar Pradesh, INDIA.

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